PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY, Limited,

167-176 TIMES BUILDING, NEW YORK.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 28 Hathaway Building, Boston.
Western Office, 465 The Rookery, Chicago.
Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION, IN ADVANCE, ONE YEAR $3.

(Including Postage in the U. S., Canada or Mexico.)

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VOL. XIX. NEW YORK, JUNE 11, 1892. NO. 24.

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Forcing the Readings of Electric Meters. PROF. AYRTON in a recent discussion in London, showed that in the Frager meter the energy could be made from 300 to 400 times greater than that indicated by the meter by simply closing and opening the circuit at proper times. With a Thomson meter he says it is very simple to force the readings with the aid of a strong magnet applied outside of the meter boxes. Fraud is therefore very easy with such meters, provided one understands how to practice it. Prof. Ayrton's remarks should be treated as a warning to designers of meters, and not as advice to the dishonest.

Electric Traction on the Third Avenue Elevated. WE are pleased to see that after months of study it appears that Professor Short is now prepared to overcome all the difficulties to be encountered in supplanting the steam power on the Third Avenue Elevated Railroad in this city by electric power. The general manager of the company does not appear very sanguine as yet, but he says his company will be quite willing to spend the large amount of money required to make the change in order to keep pace with the age. With this progressive policy on the part of the company, and with the able engineering abilities of Professor Short, we have little doubt that the contemplated change will not be regretted by any one except the steam locomotive builders, whose powerful hold on the general traction business on railroads is gradually becoming less and less.

The Relation of Hysteresis to Temperature. ACCORDING to a number of experiments made by M. Kung, of Darmstadt, it appears that the energy lost by hysteresis diminishes with an increase of temperature for the same maximum induction, it being considerably less at high temperatures than at the ordinary temperature of the room. With moderately soft iron he found the loss of energy by hysteresis at an ordinary temperature 23,490 ergs per c. m.; at a high temperature 19,180 ergs; after cooling it was again tested and the loss was then found to be less than before, namely, 21,640 ergs. The ratio of the first and second is 1.225; that of the third and second is 1.28; that of the first and third 1.085. With steel he found the differences much greater. For instance, at ordinary temperature 89,700 ergs; at a high temperature, in the neighborhood of 530° C., 42,900, and after returning to the original temperature, 65,000 ergs. At a temperature of 100° C. the ratios corresponding with those given above, but for steel, were: 1.219, 1.208, and 1.009.

The Retort Courteous. IN THE ELECTRICAL WORLD of May 28 mention was made of one of our younger contemporaries which had been indulging in what seemed to us undue self-congratulation over the publication of an illustration a week ahead of "the other papers." THE ELECTRICAL WORLD publishes illustrations and articles ahead of the other journals so often that it never thinks of saying anything about such a common occurrence. It pointed out in the item referred to some instances where the journal in question had published illustrations which had been made for and published in these columns—some of them a year or two ago. Our contemporary asks what the illustrations were, and we beg to say for its information that its illustrations Figs. 2, 3, 4, 6, 7 and 8, on pages 150, 151, 167 and 168 in its recent issues are without question copies of our cuts Figs. 1, 6, 12, 7, 8 and 9, on pages 73, 74, 98 and 97 of our issues of Jan. 31 and Feb. 7. Furthermore its cut Fig. 16, page 192, is a direct copy of our cut on page 22 issue of July 12, 1890, made by our own special artist. From what we since learn, however, it appears to have been a clear case of imposition of the author of those "original illustrations" on the editors of that journal, and we take pleasure in saying that we do not think the editors are to blame in the matter.

Peculiar State of the Accumulator Patents. OUR editorial remarks made some time ago to the effect that the lawyers often make more money out of patents than the inventors or owners do, are well illustrated by the accumulator patents in this country. There are several claimants for the fundamental patents of what is broadly known as the Faure type, and it appears to have been difficult to decide who had priority, and to define exactly what each claimant had a right to. Even in the Patent Office the decision in one case alone is said to have been reversed twelve times before the case was finally issued, showing that it was not an easy matter to decide. The two principal companies in this country have apparently been spending as much, if not more time, money and attention in fighting their cases in the courts during the past ten years than they have spent in making and improving their cells. The batteries are nearly the same as they were many years ago, improvements having been but slight. The result of their fighting is rather amusing to outsiders. It appears that each of the two companies has had an injunction granted by the courts on the other one, preventing it from using a certain part or process. But as each of these parts or processes are essential to the manufacture of such a storage battery, it follows that now neither company can make or sell. Rumors state that they are afraid to carry the case any further, as that might result in showing that neither of the patents were good, thus making the invention public property. The whole thing reminds us of a similar fight which was recorded in the following well known lines: "There were two cats of Kilkenny, each thought there was one too many, so they fought and they fit, and they scratched and they bit, till at last there wasn't left any." By making a few slight changes this little rhyme might be made to apply more directly to the two storage battery companies, in a doggerel running about as follows: "Two patents are one too many, in the fight the Co.'s spent their last penny; with grids, holes and "dry" paste, the court's time did they waste, and now there isn't left any."

The Limits of High Potential Transmission. IN discussing the subject of the practical limits of high potentials for the transmission of power, a foreign contemporary quotes from some articles published in one of our recent issues, and calls attention to the fact that too much haste ought not to be made in predicting the possibilities of the future in the use of exceedingly high potentials. The author, presumably Mr. Hospitalier, claims that our present knowledge of the action of currents at high potentials is not sufficient to enable us to predict with certainty just how currents and insulators will behave at potentials far exceeding those with which experiments and actual trials have been made. In this he confirms our editorial comments of some weeks ago. He quotes Mascart and others as having shown that it is impossible to get such high potentials as 500,000 volts in air under ordinary conditions of temperature and pressure, no matter what the distance between the electrodes is. He states that according to Mascart the striking distance between two spheres 22 millimetres in diameter is nearly proportional to the voltage up to a distance of two centimetres, but that beyond this the voltage increases more slowly than the distance for instance, at 10 centimetres it is 119,000 and at 15 only 127,800, an increase of only about seven per cent., although the distance is 50 per cent. greater. From a continuation of the curve drawn through the results obtained, he deduces the fact that the limit in air tends toward a point probably within 150,000 volts, and this is the same for a few centimetres or for many kilometres. Although objections might be made to thus continue the curve, yet he thinks that up to striking distances of one metre the curves can be relied upon. He considers it absurd to talk of using potentials of two and three million volts on bare wires in the air, as such potentials would, according to Prof. Owens, of the Nebraska University, be capable of sparking around the world. He admits that much higher potentials can be used in oil than air, but states that it is by no mean certain that oil as an insulator has all the advantages that have been attributed to it somewhat prematurely; it appears to offer much more disruptive resistance to alternating currents of the frequency of 100 to 150 volts, than to those of greater frequency, being almost the same as in air. He thinks that 40,000 to 50,000 volts is the extreme limit possible today for transmission to great distances. Beyond these figures he claims that projects can exist only in fancy and on paper. We agree with him that high potential enthusiasts should be warned not to proceed too fast, but add that in view of the present tendency in the direction of using high potentials, it would be very desirable to establish the limits more definitely by experiments.

Chicago & St. Louis Electric Express Line. ADVOCATES of electrical rapid transit between cities will be pleased to see the bold and promising beginning which is being made in the new electric line between Chicago and St. Louis, as described by Dr. Wellington Adams in his recent lecture in this city, which we give in full in another column as far as it relates to the engineering features. Dr. Adams' untiring efforts to start such a road in this country, his well chosen location and his success so far, are very creditable. There can be little doubt in the minds of electricians, who have followed the great progress of electrical traction and who understand the limits of steam traction, that the replacing of the steam locomotives by electrically propelled cars is only a question of time. That it would be practicable, there is no longer a doubt, neither is there any question about its being a safer method. The most difficult problem in the whole matter is to convince those who know little or nothing about electricity, and therefore look upon it as something mysterious. This difficulty Dr. Adams has apparently overcome successfully in that case, as there seems to be little doubt that the road will be constructed and that work will be begun soon. The preliminary surveys and plans have all been made already. The general introduction of electric traction on our present steam railroads is waiting only for some one to make a start, and we are greatly pleased to see that the first road of this kind is being started under such exceptionally favorable circumstances. With the exception of the entrances through the cities, the proposed road is an absolutely straight line, is almost entirely free from grades, and the sources of power are a coal mine and a very large water power, both located on the route. It connects two very large cities, and is intended to be finished in time for the World's Fair. Unfortunately, the electrical features of the road were not explained in detail, doubtless for good reasons, and we are therefore debarred from commenting on these. We regret, however, to learn that a system is to be used which is new and which has not been in practical operation anywhere. In our opinion it would have been preferable to use some system which has already been well tried and studied, thereby relieving this important project from the elements of uncertainty always attending the introduction of new and untried systems as distinguished from mere enlargements of our present systems. We have little doubt that, apart from the equipment, the road could be built in the short time left, as that merely requires a large force of engineers and laborers, but it is very questionable whether there is time for developing an entirely new electrical system, and to experiment with it. We would, however, be only too glad to learn that we are mistaken in this. The length of the line is 250 miles, and the trains are to be run in two and one-half hours, or at the rate of 100 miles an hour; but as the entrances to the cities are not short, this means a considerably greater maximum speed on the road. He proposes to use alternating currents of 25,000 volts on the feeders, reduced to 3,000 volts on the trolley line. The current is to be of the rotary field or multiphase kind, but the novel feature lies in the fact that one trolley line is to be used. Probably no better, more convenient, or efficient system than that using three or six phase unsynchronous motors could be wished for were it not for the fact that two trolley wires would have to be used besides the ground return. Dr. Adams' proposed improvement does away with one of these trolley wires, but it is hoped that he does not thereby sacrifice the other good features of these motors, except, perhaps, efficiency, which could well be sacrificed on a road like this, for which the power is so very cheap. We have no doubt that a rapid transit line of this kind can be constructed and operated successfully, but it may take a little experimenting before everything works satisfactorily. Dr. Adams and his associates have our best wishes that his creditable work may be a success in every way.

NEW BOOKS.

A Dictionary of Electrical Words, Terms and Phrases. By Prof. Edwin J. Houston. Second edition; 562 double-column pp., 570 ills. Price $5.00. New York: The W. J. Johnston Company, Limited, 1892. (Second notice.)

It goes without saying that there is a great demand for a book of this nature. We have but to think of the magnitude of electrical sciences, arts and industries, and the comparatively short time in which all have been developed, in order to appreciate fully the reasons for the advent of thousands of words and phrases that designate new ideas, new things and new phenomena; and to appreciate the ease with which contributors to electrical knowledge may propose new words when engaged in a line of research that is new to them, while there exist already words and phrases that are better. Many of the words and phrases designate ideas or phenomena that something more than a concise definition is requisite to make plain even to the technical reader. On account of the great activity and progress in electrical science and its applications, published text is either hopelessly behind the time, or it contains the mere elements of a branch of electrical knowledge. The great sources of this knowledge at the present day are the periodicals and papers, and discussions of learned societies in the interest of sciences and engineering. Whether the reader be layman, mechanic, engineer, student, teacher or author, his interest must be as general as it is special, for the foundation of his specialty is built of material selected from general knowledge and experience. For example, the manufacturer of underground cables finds it of advantage to learn what the dynamo builder knows about his machines, their practical performances in case of accident, etc., in order that he may know the better how to make, market, install and care for his cable. In doing this he finds that he is greatly aided by a manual that makes plain for him the terms used in connection with dynamo-electric machinery. In reading one paper after another he comes across words and phrases that have been first used in papers that have appeared much earlier, and that ofttimes are inaccessible, or require too much time to look them up. The production of a suitable work of this sort is a difficult task for its author; he must be able to apply a broad technical knowledge, combined with an ability for plainness and clearness of expression. The definitions and explanations must be technically correct, and for the greater part clear even to a layman.

Prof. Houston has most admirably worked out in this edition the ideas that he evidently entertained while writing the first edition. The plan of the work is as good as any that could be devised, and its mechanical make-up is convenient and pleasing. Concise definitions are given of all electrical words, terms and phrases that one comes across in reading electrical literature. After each definition are given, in small type, descriptions, reasons, explanations, data and laws; these are aided by numerous cuts and diagrams. The words are given in bold type; the definitions follow in ordinary print, while the explanations, etc., are given in small type for the sake of compactness. There are two columns to a page, enabling one to read the small type with as much comfort as an ordinary book. A good idea of the method and execution of the work is gained from the following examples selected at random:

Force, Magneto-Motive —— —The force that moves or drives the lines of magnetic force through a magnetic circuit against the magnetic resistance.

A Committee of the American Institute of Electrical Engineers on "Units and Standards" proposed the following definition:

"The magneto-motive force in a magnetic circuit is 4π multiplied by the flow of the current linked with that circuit. The magneto-motive force between two points connected by a line is the line integral of the magnetic force along that line. Difference of magnetic potential constitutes magneto-motive force."

The same committee gave the electromagnetic dimensional formula $L^{\frac{1}{2}} M^{\frac{1}{2}} T^{-1}$.

The flow or flux of lines of magnetic force in any magnetic circuit is proportional to the magneto-motive force divided by the magnetic resistance; or, expressing the law in the form of Ohm's law for current:

$$\text{Magnetic Flux} = \frac{\text{Magneto-Motive Force}}{\text{Reluctance.}}$$

In this formula the word reluctance is used in place of magnetic resistance. In the case of an electro-magnet, the magneto-motive force is proportional to the strength of the current which flows and the number of times it circulates; or, more simply, is proportional to the number of ampère turns. (See *Turns, Ampère.*)

Machine, Dynamo-Electric, Multipolar —— —A dynamo-electric machine, the armature of which revolves in a field formed by more than a single pair of poles.

This form is usually adopted for large machines as being more economical.

Recalescence.—The property, possessed by incandescent steel when cooling, of again becoming incandescent after a certain degree of cooling has been reached.

The property of recalescence was first pointed out by Barrett.

A steel wire heated at the middle or near one end to a bright red, and allowed to cool in a dim light, will cool until a low red heat is reached, when it will be observed to reheat at some point in the originally heated portion. This reheating is manifested by a brighter red spot which moves along the portion originally heated. This reheating is called *recalescence*, and is due to latent heat (potential energy), which, disappearing when the bar was heated, again becomes sensible (kinetic energy) on cooling.

The temperature at which recalescence takes place is sensibly the temperature at which heated steel regains its magnetizability.

The ground has been covered quite as thoroughly as is necessary. Looking over the book the writer finds words and phrases from every branch of electrical art and societies; from the applications of the "rotary current" for the universal transmission and distribution of power to the "Faradic current" for healing the sick. In addition to words and phrases that are distinctly electrical there appear many other technical words. The idea of the author has evidently been to thus include the important technical words and phrases that are not electrical, but which the reader will meet in electrical literature. The writer notices that care and judgment have been exercised in the selection of this class of words. Few definitions of this sort appear that are not of use to many. The wisdom of the adoption of this feature of the book is more than commendable. The work has been thoroughly and conscientiously performed. Certainly its author can be credited with but few sins of omission. For these the writer has sought quite in vain. After the application of many tests he found but one useful phrase that had escaped attention—this was "critical temperature." The conscientious spirit that characterized this work even in the first edition has in this one produced a volume that is as clear and accurate in its definitions and explanations as can reasonably be expected in the present state of the science. Many attempts to find slips of this nature were made with the result of finding but one that is worthy of mentioning. On the top of page 530, "Constant Current Transformer," is defined as "A transformer in which a current of constant potential in the primary is converted into a current of constant strength in the secondary, despite changes of load on the secondary." A Constant Current Transformer is one that converts a constant current of one value and variable potential in the primary to a constant current of the same or any other desired value and variable potential in the secondary despite changes of load. This is the transformer that has long been known as the Constant Current Transformer, while the modern Constant Potential Constant Current Transformer occasionally goes by that name.

The encyclopedic character of the dictionary is a most serviceable one. The explanations, data and illustrations that thus supplement the work are of great utility in giving the true meaning of a word or phrase and as an aid for refreshing one's memory. This portion of the work has also been executed with care and judgment, and we have scarce a criticism to make regarding it other than that of highest praise. It might have been well in some cases to have made the technical explanations a little more elaborate, and in others to have included important data. For example, we find under "Hysteresis" tables that are so well arranged that any one would in a general way appreciate quantitatively hysteresis values, while we can find nowhere corresponding values for the relation of induction **B** to M. M. F. **H.** for the magnetic materials. Under ampère turns we find "the practical unit of magneto-motive force is $\frac{1}{4\pi} \times$ ampère turn $=$ .0796 ampère turn. Therefore the magneto-motive force, M. M. F., is found by multiplying the ampère turns by 4π or 12.57." It seems to the writer that here it would have been well to have added that one practical ampère turn $=$ 1.257 practical units of M. M. F.

In mentioning these points I have illustrated the completeness of the work, for it will be seen that they are all of trivial importance and of the sort that only years of diligent and competent criticism can eliminate. We may illustrate the usefulness of the dictionary by considering the satisfaction with which a master mechanic will turn to it for aid as he peruses modern contributions on the design of electrical machinery, and meets such words and phrases as induction, electro-dynamic induction, electro-magnetic induction, magnetic induction, magnetic flux, magnetic density, magnetic lines of force, intensity of magnetization, etc., that either have meanings which differ but little, or, being alike, often signify entirely different things. A layman will find the dictionary of use to him at every turn of the subject. It will aid the student to grasp clear conceptions of the precise meaning of words and phrases new to him that his text continually brings before him. Mechanics, constructors and superintendents will find it of great aid to them in familiarizing themselves with knowledge of the principles and laws that determine the form and behavior of forces, materials, apparatus, machinery and appliances with which they may be concerned. Designers and inventors cannot afford to be without it. They are constantly being led to look closely into phenomena, methods, and results that hitherto have not been familiar to them, and have need, therefore, of means for quickly ascertaining the correct ideas conveyed by the new words they meet. Attorneys engaged in soliciting electrical patents must have on hand the means by which they can at short notice become familiar with the exact nature of any actual or proposed methods of working, or of any device or appliance by means of which new and useful results are obtained. It should be in the hands of every contributor to electrical literature. He will find it of service in refreshing his memory on the precise meaning that is generally attached to the technical words and phrases he proposes to use. One of the immediate results will be that he will avoid the introduction of new words when there are old ones that convey ideas which answer his purpose as well.

Harris J. Ryan.

The Ampere-Centimetre as a Unit of Magnetism.

BY CHAS. P. STEINMETZ.

With great interest I notice the proposition made by Mr. Carl Hering* of the ampère-centimetre as the unit of magnetism, the more so, as it is evidently not a mere incident that ampère-centimetre and magnetic flux are of equal dimension, but well founded in the fundamental definitions of our system of absolute units, namely, in the definition of the permeability as absolute number. So well, indeed, that the ampère length as unit of magnetism even enters into the definition of some of our most important absolute units. For, as the coefficient of self-induction, L, is defined as the ratio of the current into the magnetic flux, and the unit of self-induction being the henry $= 10^9$ centimetres, this gives as magnetic flux surrounding a portion 10^9 centimetres long of a straight wire of infinite length excited by one ampère $(= 10^{-1}$ units) the magnetism 10^8 lines of magnetic force. Hence the coefficient πK, that is, the magnetism per unit of length and per unit of current, becomes unity also for the straight line of infinite length, or equals 10^8 practical units (volt line).

Now if K is constant and independent of the radius of a circle, we have in a circular conductor (of infinitely small diameter) the magnetic flux one per unit of length and unit of current, or for the whole circle: $L = 2\pi C r$, which agrees with a well known formula.

But only for the circle and the infinite straight line is the flux per unit of length constant; in any other figure it is different. Consider an ellipse having the diameters a and b. If $a = b$, the ellipse is a circle, and the flux per unit of length of the circuit, $\pi K C = C$. But if $b = O$, the ellipse degenerates into a bifilar conductor, which, in this theoretical case, where the diameter of the conductor $= O$, incloses no magnetism, so that the magnetic flux per unit of length $= O$.

Hence for an ellipse having diameters a and b, the magnetic flux per unit of length and per unit of current can have all values between unity and zero, according to the ratio of a to b.

In the case of a medium of permeability different from unity the ampère-centimetres of the circular conductor will have to be multiplied by the permeability to give the magnetic flux.

BY ELIHU THOMSON.

On reading Mr. Hering's paper on the ampère-centimetre, the only thing which suggests itself is in relation to the ratio K. While this may be considered constant with circles formed by conductors of circular section, or by conductors the dimensions of which bear in all cases a definite relation to the radius of the turn, yet variations in the form of the section of the coil or turn will make a difference in this ratio K, assuming the coil or turn to inclose and be surrounded by air only. The ratio K approaches unity as the length of the coil or turn in the direction of its axis is increased.

Mr. Hering is quite right in saying that his deductions are based upon theoretical conditions, that is, assuming a filamentary wire of no appreciable diameter. Practically the coil or conductor will have a shape which, in relation to the radius of the turns of wire, changes greatly, and this will involve a change in the value of K. Besides this, many of the coils used in practice are not circular in outline, but more or less rectangular or oblong. I do not think, therefore, that the ampère-centimetre would be a measure of universal application, while, on the other hand, it may be quite useful in some cases.

BY TOWNSEND WOLCOTT.

The following remarks are intended as supplementary to the paper* of Mr. Carl Hering on the ampère-centimetre:

As the circumference of a circle $= 2\pi r$, x being the radius, whatever is true of an ampère turn is true of $2\pi r$ ampère-centimetres for circular coils, including as a particular case a straight line when $r = \infty$. That the total induction (or magnetic lines) per ampère-centimetre, however, is a constant only for circular coils, is easily shown.

The intensity of the magnetic force **H**, and, consequently in free space of the induction **B**, about an infinite straight conductor (not a finite straight portion of a circular conductor of infinite radius) carrying one ampère, is $\frac{2}{x}$, x being the distance from the axis of the conductor. Consider one centimetre of the conductor. Conceive a plane whose edge starts in the axis of the conductor, and which extends to infinity in one direction. The surface integral of **B** through a strip of this plane one centimetre wide, starting from the surface of the conductor and extending clear across the plane to infinity, will be the magnetic lines from one am-

*See Electrical World, May 28, p. 363.

père-centimetre. If the conductor has a circular cross-section of radius a, then this surface integral is $\int_a^\infty \frac{2}{x} dx = \infty$, which is decidedly different from the other value.

Nevertheless, both values are correct. In case the straight conductor is a portion of an infinite circle, the strip above mentioned, although parallel for finite distances, runs to a point at an infinite distance, and the integral is no longer infinite but has the value found by Mr. Hering. We see from this that it is not safe to assume that the induction per ampère-centimetre is constant for all coils o mposed of circular and straight contours, such as these, □ ⬭ for instance, which are common forms in dynamos. Moreover, in coils with iron cores the permeability of the iron comes in and we cannot determine the induction directly, but must start with the magnetomotive force, which is 4π per ampère turn for a circuit of any form whatever, and then find the magnetic induction from the magnetic resistance.

The only uncertainty is involved in the determination of the magnetic resistance of the cores. The *magnetomotive* force *between* two points is the difference of magnetic potential between the points, and is equal to the line integral of the *magnetic* force *at a* point represented by H. This is entirely analogous to the electromotive force *between* two points which is the difference of electrical potential between the points, and is equal to the line integral of a quantity which is called in the first edition of Maxwell *electromotive force at a point*, and in the second edition *resultant electric intensity.*

Test of the Neversink Mountain Electric Road.—III.*

BY HERMANN S. HERING AND WILLIAM S. ALDRICH,
OF JOHNS HOPKINS UNIVERSITY.

III.—THE LINE.

From Ninth and Penn streets to the city limits the line construction is of the ordinary overhead type, with wooden side poles and span wires. From this point over the mountain the construction is of the side bracket type, with plain undressed wooden poles and iron pipe brackets. The poles are placed 100 feet apart, but this is often varied on account of the great variations in the curvature of the road at many points, frequently necessitating pull-offs and anchor guys. The road being single track and originally intended for frequent car trips, was constructed with 14 turnouts, with the usual overhead frogs and switches. The present schedule for running the cars renders almost all these turnouts unnecessary and the company has begun to remove some of them on account of delays and jumping of the trolley, caused by having to pass these needless turnouts. On an excursion road of this kind with so many prominent stopping places, time would be saved if the turnouts were located at these stations, instead of being scattered promiscuously over the entire route, as might be called for in three-minute car intervals on a street car road.

The ground return within the city limits is made by connecting the double-bonded flat rails to a No. 4 B. & S. copper wire imbedded between the rails. On the mountain the T-rails are double bonded throughout and cross connected at two points, as shown in the wiring diagram, Fig. 8. These cross connections are made with No. 4 and No. 00 B. & S. wire. The same two sizes of grounds are used from a point on the line near the pavilion to the power house, while a third ground, No. 000 B. & S., leads from a point near the car house to the power house, where these grounds are connected to the dynamo.

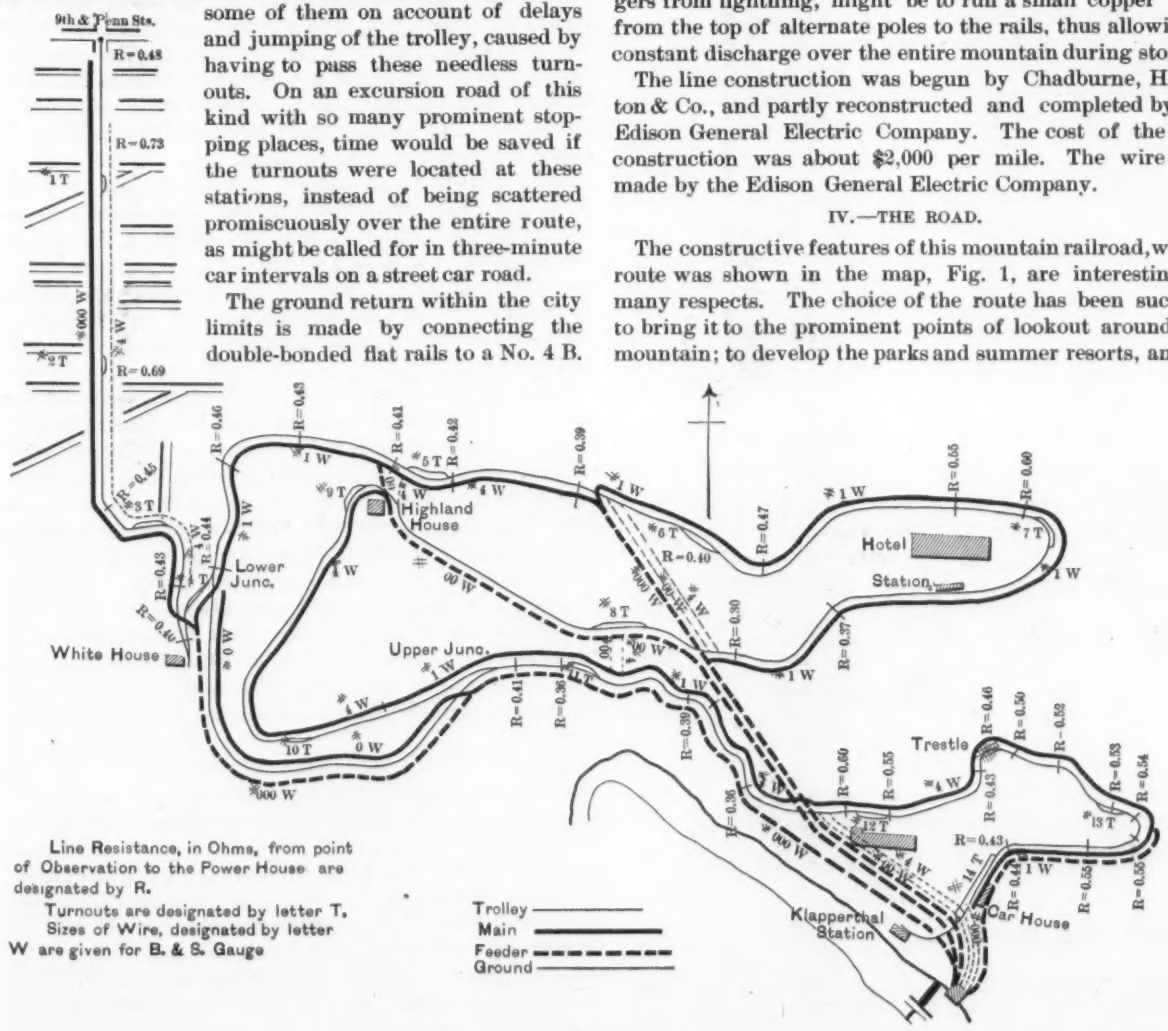


FIG. 8.—FEEDER MAP.

Four feeders are run from the power house: a No. 000 B. & S. to the White House; a No. 00 B. & S. to the Highland House: a No. 000 B. & S. to a point near Heiner's Springs on the north side of the mountain; and a No. 1 B. & S. to a point near No. 13 turnout. Mains of Nos. 4, 1, 0, and 000 B. & S. are run along the entire route, except from the Highland House to the No. 8 turnout, in which the No. 00 feeder is used for both purposes. The general distribution of the mains and feeders, and their respective sizes, are shown in the wiring diagram, Fig. 8.

The line resistance was determined at various points by taking simultaneous readings at the power house and on the car, and making the computations from the current and drop of potential thus obtained. These values are given in Fig. 8, and the mean values in the accompanying table:

TABLE III.

Mean resistance over entire line, in ohms	0.48
Maximum resistance on the line "	0.84
Minimum " " "	0.30
Mean drop of voltage, per cent (about)	6.0
Maximum drop of voltage, per cent (normal current)	10.5
Minimum " " " "	3.9
Mean line efficiency, per cent (about)	94.0

The line is protected against lightning by four Wasson gravity drop protectors, which upon every occasion have worked with entire satisfaction, though the motors and dynamos were usually cut out during heavy storms. A moderately expensive, though very effective method of protecting the line, over the mountain circuit, against dangers from lightning, might be to run a small copper wire from the top of alternate poles to the rails, thus allowing a constant discharge over the entire mountain during storms.

The line construction was begun by Chadburne, Hazleton & Co., and partly reconstructed and completed by the Edison General Electric Company. The cost of the line construction was about $2,000 per mile. The wire was made by the Edison General Electric Company.

IV.—THE ROAD.

The constructive features of this mountain railroad, whose route was shown in the map, Fig. 1, are interesting in many respects. The choice of the route has been such as to bring it to the prominent points of lookout around the mountain; to develop the parks and summer resorts, and to bring land, valuable for hotels and private residences, within easy access of the city.

Probably the most difficult portion of the road construction is on the south side of the mountain, on the sudden slope above the Horseshoe Bend of the river. At this place, for a distance of half a mile, there are eight curves, varying from 20 to 40 degrees of curvatures, all on a 3.64 per cent. grade. A view of this portion of the road was shown in Fig. 2. It will be seen that considerable cutting was necessary, often 30 feet of solid rock, to form the roadbed. Owing to its steep declivity the filling extends far down the mountain side,—the Philadelphia & Reading Railroad tracks being 300 feet below.

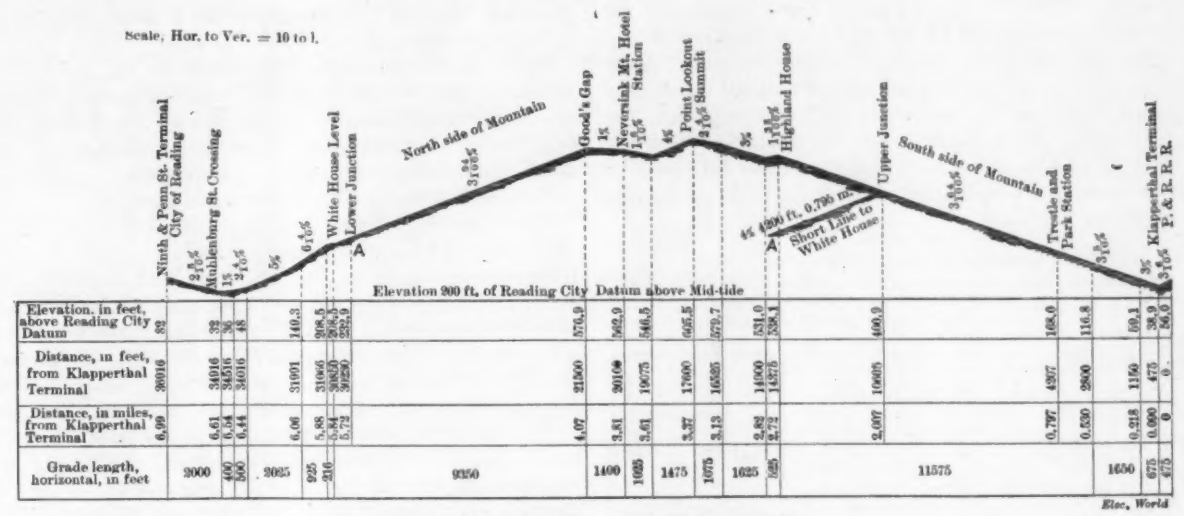

Scale, Hor. to Ver. = 10 to 1.
Ninth & Penn St. Terminal City of Reading
Muhlenburg St. Crossing
White House Level
Lower Junction
North side of Mountain
Good's Gap
Neversink Mt. Hotel Station
Point Lookout Summit
Highland House
Short Line to White House
Upper Junction
South side of Mountain
Trestle and Park Station
Klapperthal Terminal P. & R. R.
Elevation 900 ft. of Reading City Datum above Mid-tide
Elevation, in feet, above Reading City Datum
Distance, in feet, from Klapperthal Terminal
Distance, in miles, from Klapperthal Terminal
Grade length, horizontal, in feet
Elec. World

FIG. 9.—PROFILE OF THE ROAD.

The track construction over the mountain is of the railroad type, with 56-pound steel T-rails, set to standard gauge of 4 feet 8½ inches, with standard tie system of 26-inch spacing, but within the city limits ordinary flat tram-rails are used. The road is ballasted with two feet of crushed stone, and has withstood the most severe storms with no wash-outs. The surveying, grading and road construction were done by Kendall Brothers, of Reading, with the supervision of Mr. William H. Dechant, to whom the authors are greatly indebted for the road map, plan, profile, power house drawings and other valuable data, from which some of the drawings for the illustrations were made and several of the accompanying tables computed. These tables show the essential features in a concise form, and in connection with which the map, Fig. 1, and the profile, Fig. 9, should be referred to. This profile shows the elevation of the roadbed, from the Klapperthal to the Ninth and Penn streets terminal, as well as the Short Line from the Upper Junction to the Lower Junction. The elevation of grade terminals and other points, the grades, grade lengths and distances from Klapperthal terminal are given.

Table IV. shows the elevations of principal points, from the river bottom to the summit of the road.

TABLE IV.—ELEVATIONS OF PRINCIPAL POINTS.

	Above mean tide datum. Feet.	Above Reading City datum. Feet.
River bottom, below the dam	144.81	.....
Usual surface level of river, below dam	150.81	.....
Comb of Big Reading Dam	168.81	.....
Level of power house floor	176.29	.....
Reading City Datum	200.00	0.0
Lowest point of Neversink Mountain road, near Muhlenburg street crossing	232 00	32.00
Klapperthal terminal	256.00	56.00
Ninth and Penn street terminal	282.00	82.00
White House (level)	408.50	208.50
Lower Junction	432.9	232.9
Upper Junction	600.9	400.9
Highland House	738.1	538.1
*Neversink Mountain Hotel station	762.9	562.9
Good's Gap	776.9	576.9
Point Lookout (summit)	805.5	605.5

Table V. shows the usual route taken by the cars in a round trip.

TABLE V.—CAR ROUTE FOR ROUND TRIP.
Ninth and Penn street to Klapperthal via Neversink Mountain Hotel.

	Feet.	Miles.
From Ninth and Penn street to White House	5,850	
" White House to Lower Junction	836	
" Lower Junction to Neversink Mountain Hotel.	10,130	
" Neversink Mountain Hotel to Highland House	5,725	
" Highland House to Upper Junction	3,770	
" Upper Junction to Klapperthal terminal	10,605	
Total	36,916	= 6.99
Klapperthal terminal to Ninth and Penn street, via Short Line.	Feet.	Miles.
From Klapperthal to Upper Junction	10,605	
" Upper Junction to Lower Junction	4,200	
" Lower Junction to White House	836	
" From White House to Ninth and Penn street	5,850	
Total	21,491	= 4.07
Length of usual round trip, Ninth and Penn street and return	58,407	= 11.06

Table VI. contains an enumeration of road lengths, curves and grades.

TABLE VI.—ROAD DATA.

Track.		
Length of road, including short line	41,116	7.787
Length of straight track (41.5% of total)	17,066	3.232
Longest stretch of straight track	2,000	0.379
Average length of straight portions of track	304.7	0.058
Curves.		
Eight 35 to 40 degree curves, mean length	278	feet.
Two 40 degree curves are on a 5% grade.		
The longest is a 35 degree curve, 3.5% grade, length	525	"
Ten 20 to 30 degree curves, mean length	377	"
The longest is a 25 degree curve, near Highland House, length	654	"
Forty-six 10 to 20 degree curves, mean length	251	"
The longest is a 20 degree curve, 3.64% grade, length	690	"
The steepest is a 20 degree curve, 6.4% grade, length	251	"
Eighteen 0 to 10 degree curves, mean length	378	"
The longest is a 1 degree 40 minute curve, 3.94% grade, length	1,047	"
The steepest is an 8 degree curve, 4% grade, length	460	"
The average curvature (excluding straight track) of 82 curves	17.35	deg.
Grades.	Feet.	Miles.
Sixteen grades, varying from 1% to 6.4%.		
The shortest grade is a 1.00%	400	0.07
The longest grade is the 3.64%	11,575	2.19
The steepest grade is the 6.4%	925	0.18
Mean ascending grade, round trip, 3.74%.		
Total length of ascending grades	27,805	5.26
Total car-lift, round trip (as per Table VII.)	1,040.1	
Mean descending grade, round trip, 3.45%.		
Total length of descending grades	30,170	5.72
Total car-drop, round trip (as per Table VII.)	1,040.1	
Mean grade, Ninth and Penn to Klapperthal, via Short Line, 3.71%.		
Mean grade, Ninth and Penn to Klapperthal, via Nev. Mt. Hotel, 3.475%.		
Mean grade of the entire road, 3.53%.		

From Table VII., which contains what the authors have

*For the first and second sections of this article see THE ELECTRICAL WORLD of May 28 and June 4, 1892.

* Proposed location at time of writing.

termed the "car-lift" and "car-drop" data, it will be seen that on the usual route the car goes up on the steeper and shorter grades, and goes down by gravity on the easier and longer grades. Thus, the total car-lift on the round trip, which represents the sum of the differences of level on the ascending grades, is 628.1 feet—from Ninth street and Penn street to Klapperthal (via Nev. Mt. Hotel), and 412 feet on returning (via Short Line)—making a total car-lift for the round trip of 1,040.1. The sum of these ascending grade lengths is 27,805 feet (horizontal), giving a mean car-lift of 3.74 feet per 100. Similarly the car-drop, representing the sum of the differences of level on the descending grades for the same round trip, is 1,040.1 feet, in a distance of 30,170 feet, the sum of the descending grade lengths, which gives a mean car-drop of 3.45 feet per 100. The total car-drop is obviously equal to the car-lift for the round trip; but, for the sections going and returning, the difference between the car-lift and the car-drop is that due to the difference in level between the terminal points of those sections—in this case 26 feet.

TABLE VII.

CAR-LIFT AND CAR-DROP DATA.

Usual route, Ninth and Penn street and return.

	Car-Lift.			Car-Drop.		
	Grade, per cent.	Length of grades.	Lift on grades.	Grade, per cent.	Length of grades.	Drop on grades.
I.—Going: Via Neversink. Mountain Hotel	1.0	400	4.0	2.5	2,000	50.0
	2.4	500	12.0	1.0	1,400	14.0
	5.0	2,025	101.3	1.6	1,025	16.4
	6.4	925	59.2	2.4	1,075	25 8
	3.94	9,350	368.4	3.0	1,625	48.7
	4 0	1,475	59.0	3.64	11,575	421.3
	1.35	525	7.1	3.5	1,650	57.7
	3.6	475	17.1	3.0	675	20.2
Total	....	15,675	628.1	....	21,025	654.1
Difference in level between Ninth and Penn and Klapperthal Terminals			26 0			
			654.1			654.1
II.—Returning: Via Short Line	3.0	675	20.2	3.6	475	17.1
	3.5	1,650	57.7	4.0	4,200	168.0
	3.64	7,805	284.1	3.94	620	24.4
	2.5	2,000	50.0	6.4	925	59.2
	....	....	... .	5.0	2,025	101.3
	....	....	.....	2.4	500	12.0
	....	....	.....	1.0	400	4.0
Total	....	12,130	412.0	....	9,145	386.0
Difference in level between Klapperthal terminal and Ninth and Penn street						26.0
			412.0			412.0
SUMMARY:						
I.—Going	....	15,675	628.1	....	21,025	654.1
II.—Returning	....	12,130	412.0	....	9 145	386.0
Total	....	27,805	1,040.1	...	30,170	1,040.1

Car-lift per 100 feet (horizontal), round trip	3.74
Car-drop per 100 feet (horizontal), round trip	3.45
	feet.
Length of the 12 ascending grades	27,805
Length of the 15 descending grades	30.170
Length of the two level stretches	432
Length of the car route	58,407

Such civil engineering details as are contained in the foregoing tables, in connection with the route, car-lift and car-drop, furnish invaluable data for the electrical engineer in determining the performance of car motors on different grades, and also furnish much needed constants in electric traction work. All electric roads of importance should preserve such detail data of their road construction, in order to facilitate the economical equipment of the line and car; and such data will also be useful in allowing for the variations of the load at the power plant.

Between the seasons of 1891 and 1892 some alterations have been made in the road; such as widening the roadbed by cutting and filling on the steep slopes, removing some unnecessary turnouts and slightly altering the curvature of the road at a few of these points.

V.—CAR EQUIPMENT.

The road is equipped with four motor cars and four gondolas, made by the J. G. Brill Co. The motor cars are 34 feet long, with double trucks, and made especially for mountain travel. They weigh 22,000 pounds fully equipped, seat 40 passengers, and have standard 30-inch flange wheels and 3½-inch car axles (between journals). The gondolas weigh 18,000 pounds, and seat 70 passengers.

Each motor car was originally equipped with two No. 6 double-reduction 15 horse-power Sprague motors; but owing to the heavy duty required these motors were found to be too light, and were replaced by the new Edison single-reduction 25 horse-power motors. These have proved themselves to be equal to the demands of the heaviest excursion travel, at one time hauling 180 passengers on a car up the 3.94 per cent. grade at a speed of 12 miles an hour.

Fig. 10 shows the wiring diagram of the car and motors as used on the Neversink Mountain Railroad. This diagram has been kindly furnished the authors by the Edison General Electric Company, and shows the connections for two single-reduction street car motors, having three pairs of field coils each, and the motors connected in parallel.

The disposition of the weights on the driving wheels of each truck of these double-truck cars was originally two-fifths of the weight of the car body and one-half of the motor. This is equivalent to 75 per cent. of the combined weights of the motor and car body being supported on the motor axle. Under these conditions the light wheels were found to "kick up" and leave the rails under sudden torque. To obviate this trouble the Neversink company moved the pivots of the trucks toward the light wheels, so that 59 per cent. of the combined weight of car body and motors should be on the driving axle and 41 per cent. on the free axle, instead of 75 per cent. and 25 per cent., respectively, as before. Since that time they have had no trouble from this cause.

The free or light wheels have been found to flatten more rapidly than the motor wheels, an effect obviously due to the skidding when the brakes are applied at the ordinary pressure for the effective braking of the driving wheel.

Under ordinary conditions the motor wheels were found to slip quite frequently; not enough to become noticeable, however, except by careful observation of the axle speed. The speed of the motor axle during some of these slips was found to increase 50 per cent. for a period of three to five seconds.

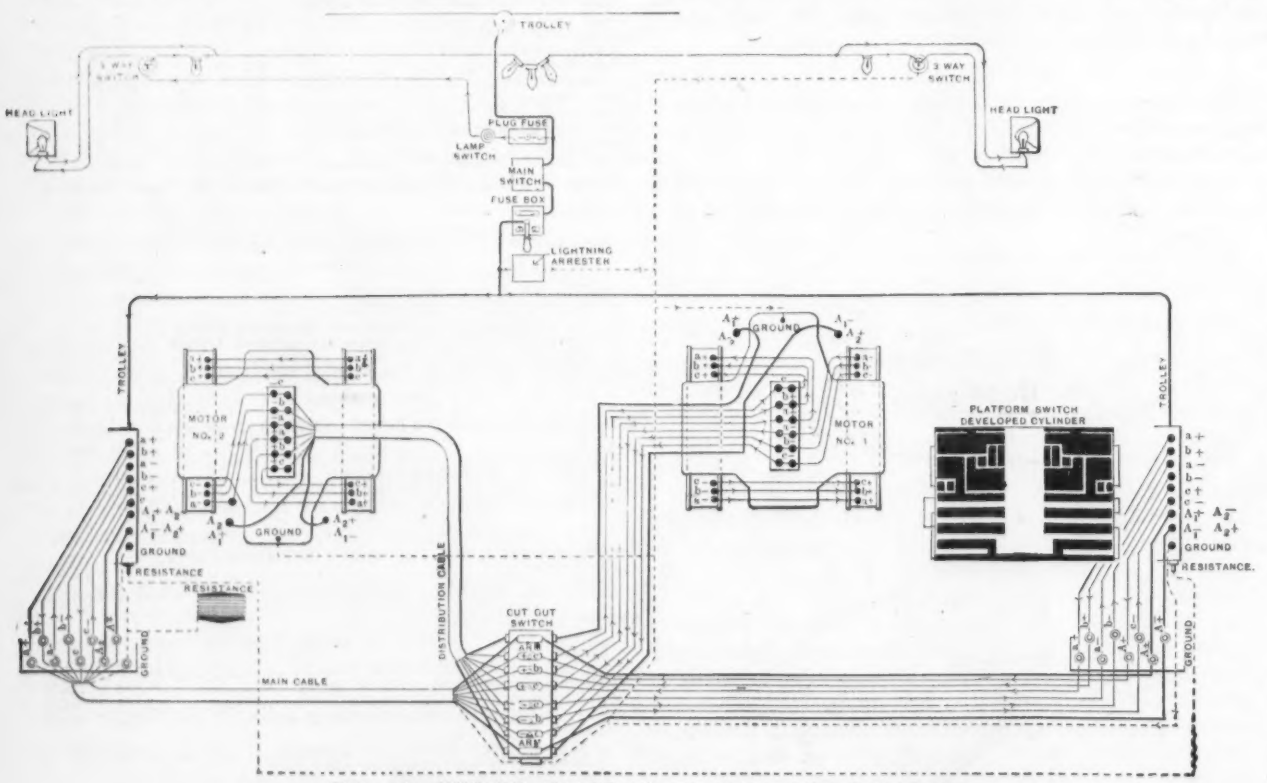


FIG. 10.—WIRING DIAGRAM OF CAR AND MOTORS.

The Advance of Electricity.*

BY EDWIN J. HOUSTON.

King Solomon, speaking of his age, said, "There is nothing new under the sun," and King Solomon was qualified to judge, for he was learned far beyond any other man of his time, and possibly beyond any who came after him. To the superficial student of scientific progress it may readily appear as if, in reality, there was nothing new under the sun. Let such student, however, once drink deeply at the fountain of scientific historical knowledge, and he will view the facts in a very different light. To assert that there is nothing new under the sun since the time of Solomon, is to assert that the human mind has made no progress since that time—has undergone no development. Certainly no one could be found willing to make such a monstrous assertion.

Ideas born out of time, like immature or unripe fruit, die an untimely death. Great ideas are conceived in different parts of the world by different brains at times often hundreds of years apart; but unless the world is ready to receive them they are unnoticed, perhaps ridiculed. Great ideas or inventions can be arranged under three great types or classes: Immature or incomplete, mature but unripe, ripe.

Ideas or inventions of the first type produce but little effect in the world—at times, however, they tend to direct thought to certain channels and thus act as forerunners of greater and more valuable ideas.

Ideas of the second type are mature, but the times are unripe for them; the condition of the environment unsuited; and therefore, though matured and complete in themselves, like unripe fruit, they produce no progeny for the development of the world.

Ideas or inventions of the third type are of far greater value to the world than those of the second type, since they bear fruit almost immediately. It matters little to the world whether they have been conceived before or not. When practicable, they must necessarily find birth or creation as soon as the times are ripe for them. The fact that such ideas are subsequently found to be old ones does not prevent them from being original with their later producers. As to this class of inventions, if the world is ripe and ready to receive them, it may happen that they may be made in different parts of the world at about the same time. Prof. Youmans expresses it as his opinion that great ideas belong to eras rather than to individuals; that intellectual progress may move in waves toward the boundaries of the unknown, and many investigators moving with that wave may, at very nearly the same time, discover new features and facts on the horizon beyond.

Let us, then, with the scientific historian, pass hurriedly over the path of the wave of electrical progress, and note the more important records left by it at different stages of its advance. Beginning with the oft reverted to experiment of the Greek Thales, it was not much, when viewed in the light of the world at its birth, some 600 B. C., merely a piece of amber rubbed against the clothing; merely the gaining of a strange property of first attracting and then repelling light objects brought near it. It was, however, the birth of a great idea that, unfortunately for the world's progress, belonged to the class of immature ideas. Viewed in the light of to-day, its importance can hardly be overestimated. It pointed out a terra incognita, an unknown realm of phenomena, that occupied nearly the entire domain of nature, and only waited patiently to be observed. However, it bore no fruit until a thousand years later.

Too often is the cry of *cui bono* raised when some apparently trifling physical phenomenon is recorded; and I have no doubt that the friends of Thales regarded him in the light of a harmless enthusiast.

The next step forward was not made until toward the close of the sixteenth century, when Dr. Gilbert, physician to Queen Elizabeth, extended the observation of Theophrastus (the latter made in 300 B. C.), and showed that many bodies beside amber and tourmaline, when subjected to friction, acquired the strange property of attracting and repelling light bodies brought near them. He divided bodies into two great classes: electrics, or those which could be electrified by friction; and non-electrics, or those which could not be so electrified. But we have since discovered that this classification was based upon an erroneous idea.

After Gilbert come Stephen Gray, who, in 1729, first pointed out the distinction between conductors and non-conductors of electricity; and Dr. Franklin, in 1748, set fire to spirits of wine by a current of electricity sent across the Schuylkill River, using the river and earth as return. It would seem that the telegraph belonged to inventions of the immature class, and at this time necessarily died without bearing fruit.

1745 was a memorable year in the history of electrical progress, for it was in this year that Von Kleist, Dean of the Cathedral of Comin, in Pomerania, made the discovery of the Leyden jar. This invention belonged to the type of ripe inventions, and naturally enough we find several claimants for its first conception. As far as I have been able to trace original records, it would appear that its first discovery was made by Von Kleist, in 1745, although Muschenbroek or Cunæus, of Leyden, also claimed the discovery.

Perhaps some of the most important investigations that have been made in recent years have been those of Nikola Tesla, concerning the effects produced by discharges of alternating currents of high potential at extraordinary frequencies.

Tesla has shown by a series of experiments that are unique both for their completeness and wide scope, that for discharges of enormous frequency ordinary conductors become absolutely non-conductors, while such substances as vulcanite and glass, that for ordinary currents possess the highest powers of insulation, are readily traversed by such discharges. He has proved that the physiological effects of such discharges are much less marked than are those of constant currents or of alternating currents of but moderate frequency. He has made many other valuable discoveries; indeed, the investigations made by this acute observer have almost opened, so to speak, a new science within the comparatively new science of electricity.

An exceedingly important discovery concerning a peculiarity of the discharge of the Leyden jar was made in 1842 by Prof. Joseph Henry, of America. This discovery refers to the peculiarity concerning the nature of the disruptive discharge of such jar; and it is on the line of this peculiarity that most of the recent developments of this instrument have been made.

The idea concerning the flow of electricity through a wire is apparently an exceedingly simple one. Up to a very recent date it was believed that electricity passed through the substance of the conductor. However, our modern views have changed profoundly in this respect. According to

* Abstract of a lecture delivered by Prof. Edwin J. Houston, of Philadelphia, before the Department of Electricity of the Brooklyn Institute of Arts and Sciences, Brooklyn, N. Y., June 1, 1892.

Poynting and others, the energy of electric discharges is not propagated or transmitted through the conductor, but through the ether which fills the interatomic or intermolecular spaces or the medium lying outside of the conductor as well as within the conductor itself. It is this medium which is known in science as the dielectric, and is ordinarily looked upon as the non-conductor or the insulator of the wire. For example, in the case of a telegraph wire strung on insulators and passing through the air between the two stations, the air and the glass insulate the said conductor from the earth. According to the modern theory of the propagation of electricity, however, the electric energy is in reality transmitted through such non-conducting paths, and is rained down on the surface of the conductor from the space outside it, the conductor acting merely as a sink or place where the electric energy can dissipate itself. The electric energy is, therefore, really propagated through the so-called non-conductor and expends its energy or manifests its characteristic effects in the conductor itself.

As we all know, ships at sea are very liable to be injured by lightning, and until William Harris, of England, proposed a system for the electrical preservation of vessels, many good ships were destroyed by such discharges. Harris' proposition to place lightning rods on ships, like many propositions for the good of mankind in general, were first received with very great disfavor by the public. Prior to Harris' time some little attempt had been made to protect ships from lightning; but ineffectually. The rods were passed along the masts of the vessel, often but a single rod on the main mast, which was carefully separated from any mass of metal in the ship and passed down into the water from the end of the bowsprit. Such a lightning rod, like an incompetent physician or lawyer, was worse than useless—indeed, dangerous; and considerable discredit was thrown on the protective power of lightning rods for such reason. Harris suggested the necessity of connecting the lightning rods with the copper sheathing of the ship's bottom, and with all masses of metal in the ship, and especially with the metal covering of the outside of the powder magazine. He was regarded as an innovator of the most dangerous type; but his invention was applied and proved most successful. As a result he was given the honor of knighthood.

It was not until the great and only Faraday conducted that magnificent line of experiments between 1831 and 1832 on the means for producing electricity from magnetism that the road was opened up for the production of a new electric source in a dynamo-electric machine. Nor was it until Sorens Hjorth and Gramme, together with numerous others, produced the modern dynamo that a ripe invention was offered to the world. The successful production of the modern type of dynamo machine probably found its first exponent in the completed Gramme machine. This machine gave that impetus to electric science which, beginning about 1874–75, has continued to the present day, and furnishes one of the best examples of remarkable progress along a particular line of science that the world has ever seen. To attempt to trace the history of the dynamo-electric machine would carry this paper to undue length. Faraday built far better than he knew. Could he see the many forms of dynamos which are in all parts of the world now converting mechanical energy into electrical energy, with wonderful efficiency, he would thus appreciate the almost immeasurable gift that he freely gave to the world.

The invention of the modern dynamo made possible the invention of the electric motor, which during the past few years has been successfully carried to an extent that appears almost incredible. Electric motors of efficiency as high, or even higher, than 90 and 95 per cent. can be produced. Contrast this with the efficiency of the modern triple expansion steam engine. I believe in that case 17 per cent. would be regarded as higher than the facts usually warrant.

Let us not overlook the telephone.

An outgrowth of the telephone appeared in the phonograph, the invention of Edison. This instrument is familiar to all.

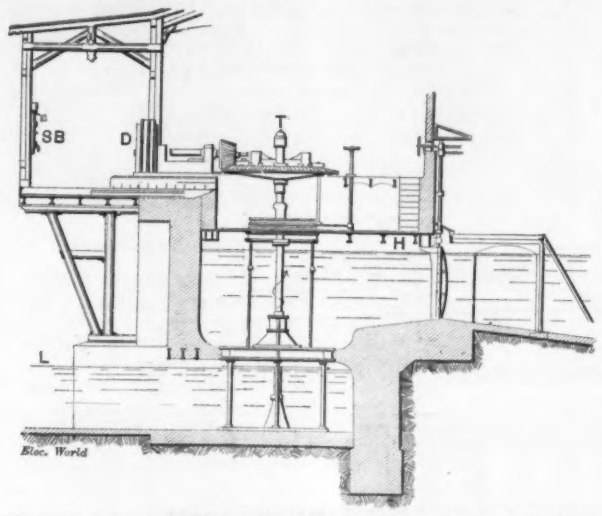
There are many other inventions which lack of time compels me to pass unnoticed. I know how dangerous it is, even under the most favorable circumstances, to assume the position of a prophet; yet I desire to venture a few suggestions concerning what seems to me electric science has in store for the human race in the near future.

1. A cheaper means for the production of electricity than is now obtainable by burning coal for the purpose of driving a steam engine, which in its part turns a dynamo-electric machine. This invention will probably be found in some improvement in thermo-electricity, whereby coal will be burned directly to produce electricity, and not through the double intervention of the steam engine and the dynamo.

2. The entire replacement of the steam engine by the electric motor. I do not think it unreasonable to believe that many in my audience to-night will live to see the steam engine relegated to the scrap pile as antiquated and possibly even to hear it spoken of in their times as an indescribable instance how an otherwise bright age should remain satisfied for so long with such a clumsy contrivance for the conversion of energy.

3. The successful solution of the problem of aerial navigation, effected possibly by means of the electric motor, resulting from the improvements in the production of electricity. In my own mind this problem needs for its successful solution only a means for obtaining great power with small weight.

4. The replacing of the electric light, that is, the present electric light, with its preponderance of useless and injurious heat energy, by some means of electrically produced light, which shall possess a smaller proportion of the useless heat rays and a larger proportion of light rays. Though this discovery may come by the discovery of some means of producing cold light by chemical phosphorescence, yet it would seem more probable that it would be by means of physical phosphorescence or by means of molecular bombardment, as pointed out by Nikola Tesla in his classic experiments on the effects produced by alternating currents of extraordinary high frequency and difference of potential.



SB, Switchboard; *D*, 200 kw. Dynamo; *T*, 300 h. p. Turbine; *H*, High water level; *L*, Low water level.

FIG. 2.—SECTION OF TURBINE AND GENERATOR.

5. A more intelligent means than is now adopted in the therapeutical applications of electricity to the curing of diseases, whereby human life may be considerably prolonged and human suffering lessened.

Multiphase Transmission and Distribution of Electric Energy.—II.*

BY A. RECKENZAUN.

At present there are two turbines and two dynamos in operation at Lauffen; the third set is in course of construction, and is mainly intended as a reserve set. The turbines are of the vertical type, made by the Maschinenfabrik Geisslingen; they run at 35 revolutions per minute, and drive the three-phase generators through bevel gearing. The generators, one of which supplied the current for the Frankfort-Lauffen plant during the exhibition, are too well known to require detailed description. Each makes 150 revolutions per minute when giving 4,000 ampères with 50 volts. The machine consists of a stationary armature with solid copper bars, and a rotating field with a single bobbin and 32 poles, made to the designs of Mr. C. E. L. Brown. Fig. 2 shows a vertical section through one set of turbine and generator.

The transformers, unlike those used during the exhibition, are not inclosed in oil tanks. They are placed into a separate transformer house, shown in Fig. 3, which also contains the necessary safety cut-outs. By means of this superposed arrangement, it is easy to get at every part of the transformers and their connections to the transmission leads and safety devices. The government of Wurtemburg has been very exacting in the matter of safety appliances,

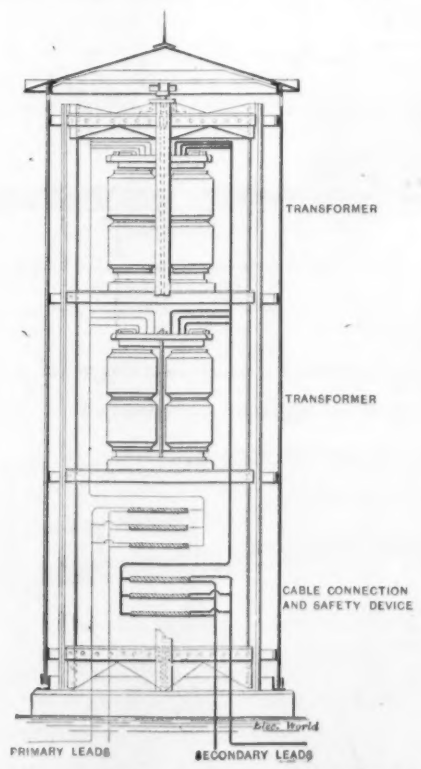


FIG. 3.—VIEW OF TRANSFORMER HOUSE.

especially those placed at the village Southeim, which lies half-way between Lauffen and Heilbronn. At Southeim is a 20-kilowatt transformer station for local consumption, containing the transformer in a locked-up room, and a switchboard with instruments and safety devices, as, also, a telephone. The telephone circuit runs on the same poles as the transmission leads, and is only about 28 inches below them. It serves the double purpose of telephonic communication and as pilot wires for taking measurements. The telephones are said to work admirably in fair weather, and that only during very strong winds can any disturbance be observed. Messrs. Reiner, of Munich, have provided transmitters and receivers of a special design to work in proximity of the "drehstrom" circuits with the least amount of inconvenience to the users of the telephone line. During a storm, when the overhead wires assume varying positions relatively to each other, sufficient induction is set up to make telephoning difficult.

Animated discussions have recently taken place in Germany between the postal authorities and electric light engineers on the subject of interference with telephones and telegraphs. In fact, special laws are being passed to protect the government from disturbances created by the increasing use of heavy currents for purposes of transmission of electric energy. To judge by the fierce arguments at the meetings of the German electrical societies one is bound to come to the conclusion that there are two opposing parties. One, a conservative party consisting of telegraph and telephone engineers backed by government officials, who are called "schwachstrom" (weak current) engineers, and the progressive party composed of "starkstrom" (strong current) engineers.

The consumers at Heilbronn are supplied with electricity meters devised for three-phase circuits by Dr. Aron. A special kind of arc lamp, of which either two or three runs in series, has been constructed by Messrs. Korting and Mathiesen. Motors of from two to 15-h. p. capacity are being made by the Allgemeine Elektricitäts Gesellschaft. These motors are self-starting, run at constant speed with varying loads, have no commutators, and are reversable. With the exception of charging accumulators, this multiphase system has the combined advantages of the alternating and the continuous current systems without the disadvantages of either.

A New Electric Launch.

Those who had the pleasure on last Friday afternoon of being present at the trial trip up the Passaic River of the Electric Launch and Navigation Company's new storage battery launch "Electra" had a good opportunity to see what progress had been made in this line. This launch was designed for the transportation of passengers on the lagoons of the World's Fair Grounds, and will immediately be shipped to Chicago to compete with steam and other forms of launches for that service.

The launch is 34 feet over all and 30 feet on the waterline, has a breadth of 6 feet, and a draught of about 27 inches. The total weight is approximately three tons. The hull is made of cedar, the frame of oak, and the deck finished in highly polished mahogany, which gives the craft an exceedingly neat appearance. Around the hull, about four feet apart, are brass rods for supporting a canvas awning. The cells used are those made by the Consolidated Storage Company, and are 78 in number, each cell being calculated for two volts and weighs about 38 pounds. At present they are divided into two sections, of 39 cells in each section in series with one another. When the motor is developing 4 h. p. at a normal load of 35 ampères and about 75 volts, these two sections are thrown in multiple, which gives the launch a speed of seven miles an hour. In circuit with the motor is placed an extra resistance of five ohms, which is very neatly arranged on the starting device.

The motor, which is the invention of Mr. Reckenzaun, is especially compact in every detail, the total weight being only about 420 pounds. It is series wound, has a Gramme ring armature and carbon brushes. The speed is 650 revolutions per minute and the screw necessarily turns at the same rate, as it is connected directly to the armature shaft by a well designed flange coupling. A few feet further aft from this flange coupling is a thrust bearing which is rendered necessary by the forward thrust of the screw. At this point the shaft runs through a bronze journal with ball bearings and this is placed in an iron box and about three-quarters filled with oil.

This bearing is one of the most noticeable mechanical features of the launch. The motor shaft is of steel, while the shaft running to the screw, which is 14 feet in length and 1¼ inches in diameter, is made of "Tobin" bronze. The diameter of the screw is 18 inches and its pitch 12 inches.

As everything is concealed under the floor, and as the motor runs with practically no noise, the uninitiated passenger is at a loss to know what drives the craft.

The contract calls for the development of 4 h. p. and a speed of five miles an hour for 12 hours without replenishing, but recent tests show that nearly 6 h. p. is developed for the required time, so that the company evidently has a safe margin in its favor.

It is the intention to eventually connect all the 78 cells in series, so that a maximum of nearly 14 h. p. can be obtained with a speed of 11 miles per hour, but of course the cells would necessarily have to be replenished much oftener than under the present arrangement.

* From the *Electrical Review*, London. For the first section of this paper see THE ELECTRICAL WORLD of May 21, 1892, p. 351.

From Chicago to St. Louis by Electric Express.*

BY DR. WELLINGTON ADAMS.

I noticed a short time ago a couplet in one of the periodicals of the day, which ran like this: "Will you walk a little faster said a whiting to a snail, there's a tortoise close behind us and he's treading on my tail." It struck me as beautifully exemplifying the evolution of the art of propulsion. We certainly live in a very rapid age, an age which unquestionably demands more facilities for rapid transportation, and it is a very remarkable fact that with each step in advance that some demand for a still more rapid transportation has existed. Going back to the days o. Bianconi in 1815, when he started the first horse tramway in Ireland, as a curly-headed Italian gilder, he appeared before the public not knowing anything about railroads; in fact they did not exist. There was no art of propulsion, and he advocated the establishment of a line 12 miles long to be operated by horses. He was ridiculed. It would be impossible to make such an affair pay. Who would care about riding in a horse car and paying one shilling six pence, when they could just as well walk for nothing. But no sooner had Bianconi started his road than people were wanting to know if it would not be possible in the future to travel more rapidly. And again if we look back to the time when Stephenson had the audacity to advocate the propulsion of cars across the country with his little 4½ ton locomotive at a speed of 12 miles an hour people at first ridiculed the idea similarly, and said that it would be utterly impossible to whirl people through the air at such an astonishing rate of speed. A very intelligent committee considered the whole project absurd, but no sooner had Stephenson started his "Rocket," in 1829, than people began to look for something more rapid than 12 miles an hour. And so it has been. All these people who have advocated startling advances have ever in their age and generation been considered cranks. I am proud to likewise be known as a crank. Oliver Evans, in 1805, when he advocated steam locomotion was called a crank; his ideas were ridiculed; the same way with poor John Fitch when he advocated steam navigation and operated his little boat down on the lake in this city where the Tombs now stands. Though he had fully developed and demonstrated the feasibility of operating boats by means of steam, he found it utterly impossible to introduce it. It was not until a great many years afterward that it became an accomplished fact, in 1815. The same may be said of Edward Somerset, who, a whole century before Bolton and Watt, endeavored to introduce steam for motive power purposes generally; although he had wealth and position at his back, yet he found it utterly impossible to introduce it and he was met on every hand by the utmost ridicule.

For a long while I have advocated the use of electricity for long distance railroading, and particularly for the operation of high speed cars; in fact I began advocating it in 1884. But I have found it utterly impossible to do anything until the last year, and have been aided in my ability to do something within the last year by the advances which have been made so generally throughout the country in the direction of the electrical transmission of power. While in Europe last summer I formulated the idea of building a long distance high speed electric road, and after consultation with some of the leading engineers over there on the subject I determined, upon my return, to inaugurate the project. On my return I looked over the country very carefully.

After considering quite a number of routes between some of our large cities, I found that between Chicago and St. Louis we had 250 miles of a practically level country, and the circumstances rendered it particularly adaptable for the construction of a straight line. There are now but two roads running in nearly a straight line between St. Louis and Chicago, but they are, nevertheless, quite circuitous, and run upon either side of a straight line. I found out, on reconnoitring the territory, that it would be practicable to build an absolutely straight line between these two cities, and that we would have about 200 miles of country that would be practically as level as a floor. Then I took into consideration the fact that we were about to have the Columbian Exposition in Chicago, so that this became the opportune time and the object in point for such a road. We then formulated our plans of the character of the road to be built, and the way it was to be operated, and when we had come to the conclusion that such a scheme was practical, we started out a corps of engineers to locate a straight line between those two cities. We started them out on three different lines, using the government triangulation stations as starting points, and those three lines were followed up in an absolutely straight course, not stopping for anything.

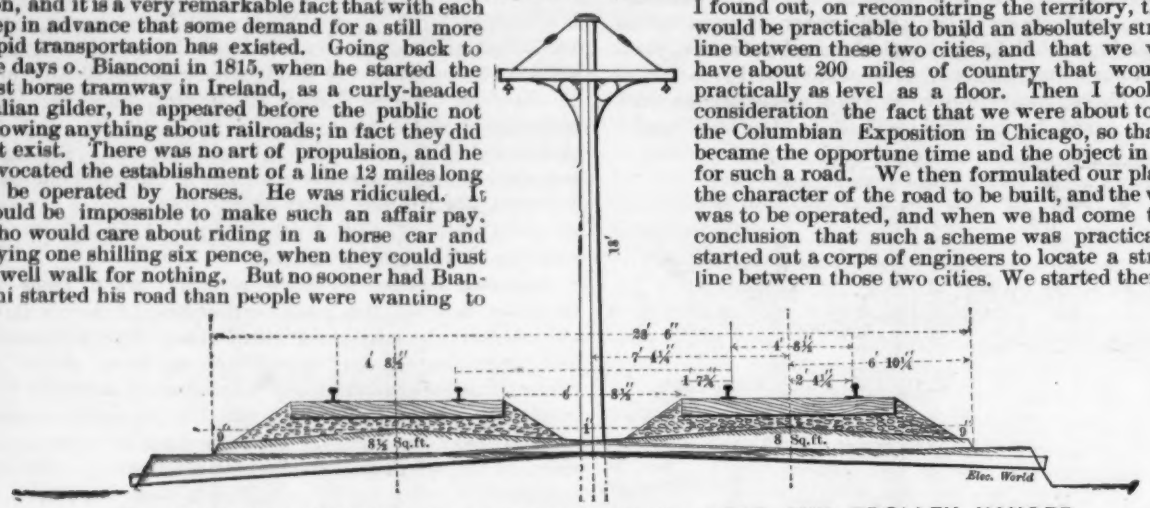


FIG. 1.—CROSS SECTION OF TRACK SHOWING POLE AND TROLLEY HANGER

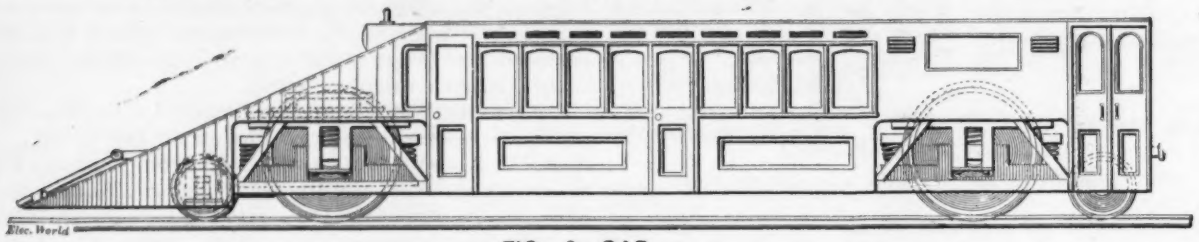


FIG. 2.—CAR.

We found one of those lines to be entirely practicable, that is to say, we met with no insurmountable difficulties. According to our survey the distance amounted to 248 miles between the two cities, thus shortening the shortest existing steam route by 34 miles, the shortest one at present being the Chicago & Alton, 282 miles. Our maximum grade would not exceed two per cent., and that will occur only at one or two places in Madison county, near St. Louis. There are two places where we get a grade of two per cent., due to the ordinary contour of the country. Of course we have 20 grades at two per cent. at the railroad crossings, but these are so short that they are not to be considered, because the impetus of the car is such that it would go over that grade, even though the current were all turned off; the approaches are only 1,000 feet long.

At the present time there are over 1,200 people a day traveling between those two cities as through passengers, aside from those who travel back and forth between Springfield and Chicago, Springfield and St. Louis, Bloomington and Chicago and Bloomington and St. Louis and the other way stations and intermediate cities. It is also estimated that during the World's Fair there will be 30,000,000 persons in Chicago visiting the Fair. We feel that this road if constructed will be a curiosity of the World's Fair, and we feel that we are not making an exaggerated estimate when we say that 10 per cent. of these people will travel over the road through curiosity alone. Therefore if 3,000,000 travel over the road, providing we put the fare at $5 for the round trip, there would be an income of $15,000,000 for the six months, and it requires only $6,000,000 to build the road.

We propose locating along this line two central stations. We started out with the idea of having only one, but came to the conclusion to have two stations, simply because something might happen to one and then the other would operate the whole road.

We found two points that were just properly located for central stations and at those points we found at one place a coal mine and at another a water power. At one point we have a water power of 10,000 h. p. for 10 hours in the day; this is at Wilmington, about 60 miles from Chicago. Five hundred thousand dollars were spent there on this water power 15 years ago by a company, but the thing has been lying idle ever since. Everything is complete and in readiness for the turbine wheels.

Then at the other station there is a coal mine which we are negotiating for. The mine is already located and in operation, taking out 1,500 tons of coal per day of the finest coal in Illinois. With central stations at these two points we can divide our road up into four equal parts, thus establishing four equal circuits of 55 miles each. We have been very fortunate in having been enabled to secure 60 per cent. already of the right of way. Of course there will always remain an amount that will have to be condemned, but land of this character will not be more than three per cent.

We say that it is absurd to carry people in a circuitous route who wish to go straight from Chicago to St. Louis. We will take these people in the most direct line, and we will run a sider out here to Clinton and another sider out here to Decatur, and so on: we will have separate cars plying between Bloomington and St. Louis, others between Springfield and Chicago and still others between Springfield and St. Louis, and so on. The cars that start out from St. Louis to Chicago we propose to run without a stop at the rate of 100 miles an hour and make the trip from St. Louis to Chicago in two and a half hours. We propose to build two tracks for through traffic, but the scheme is to ultimately build four tracks, two heavy tracks for traffic at the rate of 100 miles an hour and two outside tracks with lighter rail for local traffic, running very much on the same plan as a street car system.

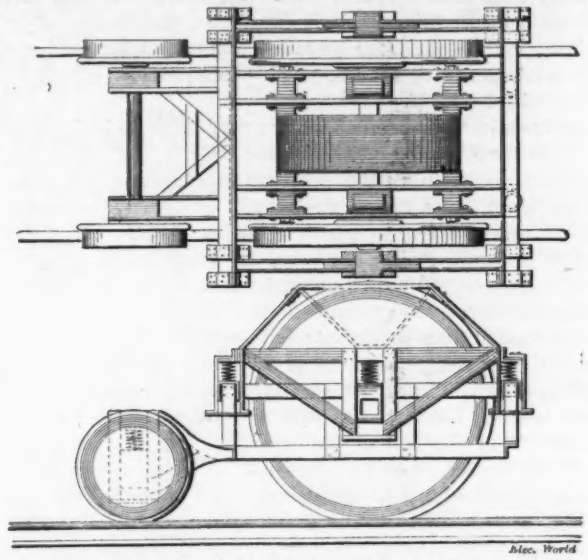


FIG 3.—SIDE AND PLAN VIEW OF TRUCK AND MOTOR.

The starting point in St. Louis is from the Union Depot, over the elevated tracks of the Merchants' Terminal Company and over the Merchants' bridge, and from this point, in an absolutely straight line, to the entrance into Chicago. Of course in the city we have curves, and for that reason, in order to make it possible to get into the city cheaply and conveniently, we have constructed each car with reference to making curves of small radius.

In our entrance into the city of Chicago we come by Ninety-fifth street, until we reach the Alley Elevated Road. This connects us directly with the entrance to the World's Fair and with the Auditorium and other hotels.

Fig. 1 is a cross section showing the proposed construction of the roadbed. We have concluded that in order to operate a road from the start at a high speed it will be necessary to have a very nicely constructed and an unusually well drained roadbed.

You all know that it is because of improper drainage that we have trouble with the joints of rails. When the rolling stock strikes the ends of these rails the defect is rapidly increased, owing to the little puddle of water that collects underneath the joint. We propose building the two tracks on two separate and distinct roadbeds. There is a sub-grade sloped on both sides affording good drainage, with a ditch in the centre and a ditch on either side. The centre ditch we drain occasionally by tile shown. We propose using a 70-pound Bergen or California rail, which does away with the ordinary fishplates and joints, and to ballast the road completely with stone.

There is to be an overhead construction consisting of central poles and cross-arms, with trolley wire coming from the side of the car. We propose leading all highway crossings over our road, which is rendered possible by reason of the very low car which we propose using, the car standing only 9 feet from the top of the rail. It enables us to use shorter, lighter poles and cross-arms. Instead of having the

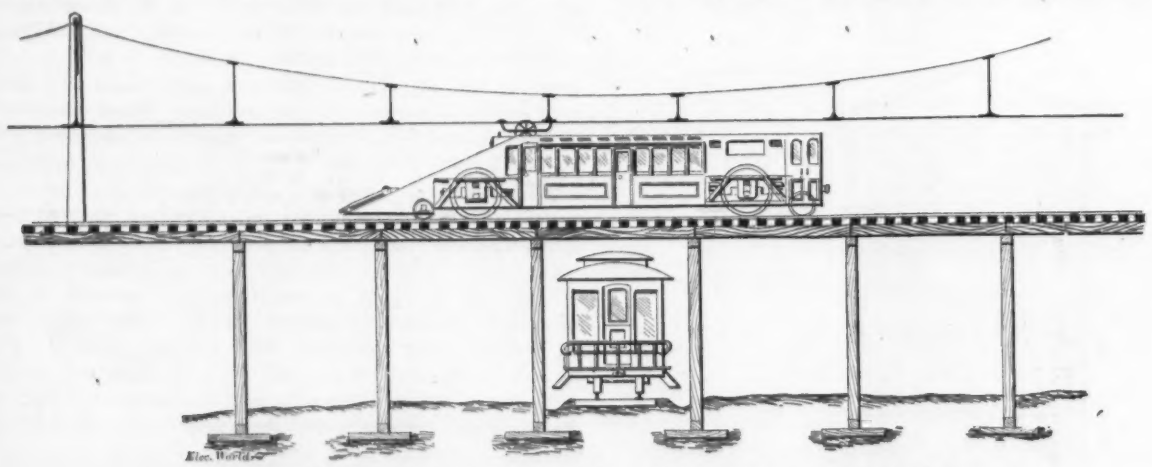


FIG. 4.—SIDE VIEW OF OVERHEAD STEAM ROAD CROSSING.

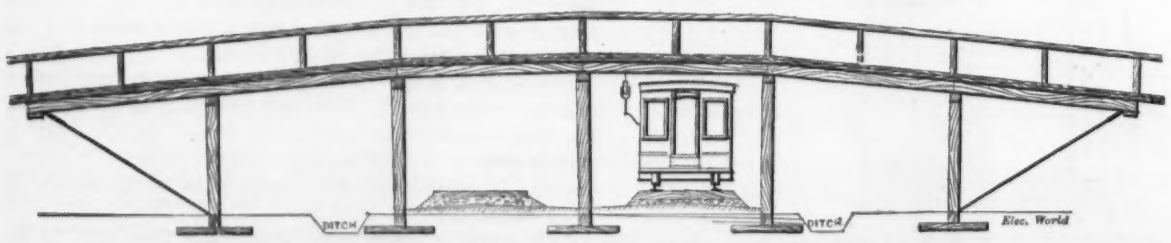


FIG. 5.—SIDE VIEW OF OVERHEAD HIGHWAY CROSSING.

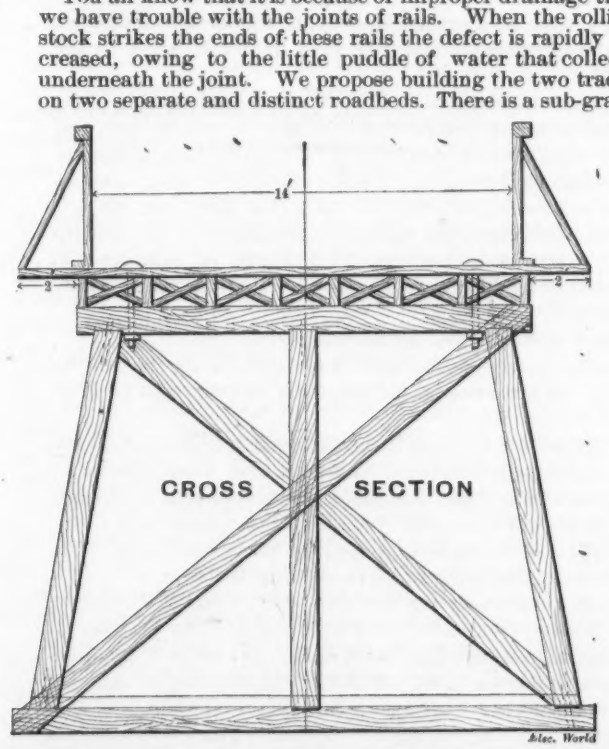


FIG. 6.—CROSS SECTION OF OVERHEAD HIGHWAY CROSSING.

* Abstract of a lecture delivered before the Electric Club of New York; from THE ELECTRICAL WORLD's stenographic report.

trolley wire over the centre of the car we propose to lead it on the side of the car practically on a level with the roof, thus making the trolley wire approximately nine feet from the top of the rail. The road will be fenced in on both sides; the cost of the fencing will be $165 per mile of fence.

Fig. 2 is an illustration of the proposed car. You will notice that we have a very low car, and that the centre of gravity comes below the centre of the driving axles. There are two trucks, one at either end of the car, pivotally connected with the car as an ordinary bogie truck on a steam

FIG. 7.—VIEW OF STATION SITE AT MOUTH OF COAL PIT.

car, or passenger coach, in order to cheapen the cost of entrance into the cities by enabling us to get round sharp curves. The weight of nearly all of the truck and of the car comes upon the two driving wheels, the support being immediately over the centre.

As regards the construction or form of the front of the car, we wanted to decrease as much as possible the atmospheric resistance and for that reason decided to make the front of the car pointed, but of course it would be impossible to do away entirely with atmospheric resistance, and we concluded to utilize what remained to help keep the car upon the track and increase the adhesion between the wheels and the truck, for which reason we adopted this semi-cone or semi-pyramidal shaped front. Then, again, this construction acts as a cowcatcher removing obstructions on the track, while a cigar-shaped front would tend to lift the car from the track and cause derailing because of the obstruction. Of course we are well aware that we have an atmospheric resistance at the rear of the car, and that this could be decreased by the same construction, but we felt that that was not as serious a consideration as was the necessity for having a construction which would admit of coupling two cars together with a continuous surface.

The entrance is on the side, the main part is devoted to passengers, the front end is for the motor man, and the rear is a department for mail and express. We are building one of these cars now.

Fig. 3 will give you an idea of the detail construction of the truck or bogie. The drivers are six feet in diameter; the small wheel is 31 inches in diameter. About 95 per cent. of the weight is on the drivers. The drivers have outside boxes with spring mountings above it, and three springs on each side. Some of these springs prevent a turning of the truck frame proper, by any obstruction encountered by the front wheel, and prevents bending between the axle box and the pedestal: in other words, they limit it to a vertical movement purely. This makes a very light and yet a very strong construction for the truck. We propose putting a motor on each one of these driving axles. Each motor will weigh 6,132 pounds, and will have a capacity of 200 h. p. and a speed of 500 revolutions per minute, in running at the rate of 100 miles an hour. This low speed will not give us an excessive friction at these bearings.

The plan shows a view of the motor frame. It is modeled on the plans suggested by me in 1884; it is journaled on the axles, and is supported by springs at the other ends. The figure shows a correct view of the motor, and it is just as simple as it appears there. It is an alternating current motor; there is neither commutator, brushes nor switch in connection with it. The armature is mounted directly on the axle rigidly. The field is journaled upon the axle, and is held from turning about the axle by the springs to which I have just called your attention. Of course we have taken into consideration the deleterious effect of the blows on the motor, running direct on the rails in such construction. To meet this difficulty we have designed a special wheel which cushions the entire motor, the cushion being in between the periphery of the wheel and the central portion. It will allow of a movement, if desired, of at least half an inch. It is thoroughly cushioned on rubber springs, not only for vertical blows, but also for the torque or turning movement. Upon the axle of the small wheels we expect to locate a rotary pump for an airbrake, according to the plans that have recently been brought out by Mr. Westinghouse. We propose to use an airbrake of that character as a means of braking our car in connection, of course, with the electric motor and electric brakes.

Fig. 4 illustrates a standard railroad crossing; we have 20 of these on the line. They could be constructed for $10,000 a piece; they have approaches of 1,000 feet on either side, the grade of which will be two per cent. It also shows the construction of the overhead line. We have given this matter a good deal of attention. Of course the ordinary construction of a trolley line would be out of the question for this road at such a high speed; there would be too much sinuosity or curvature in the trolley wire to admit of such a high speed; it would be like running the trolley wheel up against an obstruction all the time. This construction gives us a practically straight line for the trolley wire. We use a longitudinal cable, as shown, which has a large catenary and, as you will understand, this will give us a very small amount for change at the centre for expansion and contraction.

For the contact we use a combination of a sliding contact and a trolley wheel. The latter is 12 inches in diameter, and is constructed like a bicycle wheel. The wheel is intended to keep the trolley or contact upon the wire. A sliding contact at that speed, if constructed under the ordinary plan, as they were constructed, for instance, by Prof. Short, would, of course, be impractical; if we can get a sliding contact here with only a light pressure upon the trolley wire, and a uniform contact upon the trolley wire, then a sliding contact will be practically vertical, and give us an extensive surface, and enable us to lead off a large current, an average of 100 ampères, which is, of course, a very important feature. No matter what position the trolley arm assumes the pressure between the sliding contact and the trolley wire will remain constant, and thus capable of initial adjustment. Then, again, if the front contact meets an obstruction it is thrown down, which simply places the rear one in closer contact with the trolley wire.

Fig. 5 shows you the construction of the highway crossing. The grades on the approach are eight per cent. This can be put up for $310, and there are 246 of them on the whole line; we have saved enough in the overhead construction to more than pay for all of these crossings.

Fig. 6 represents a cross-section of the highway crossing. It will be 14 feet wide, giving sufficient width for teams to pass.

The general character of the generator we expect to use is like the one that was used at the Frankfort-Lauffen power installation.* We propose to use a rotary current or multiphase system. We do not expect to use a tri-phase system or a bi-phase system, but we have got worked out a system which involves an alternating current motor and we have got the system all put up complete. We propose to divide the line up into 25 sections of 10 miles each, and in the centre of each one of those sections we propose establishing a local transformer station, where we will bring 25,000 volts of the feeders down to a voltage of 3,000 volts, which current will be led into the trolley wire direct. The current will be 500 volts at the generator; this will be transformed up to 25,000 volts, which will be sent out over the main leads to each 10-mile section. At the ends we have transformers which bring down that pressure from 25,000 to 3,000, which is led along the trolley wire.

Figs. 7 and 10 represent our central station at the coal mine shaft at Edinboro; here are the shaft, smoke stack, coal chute, brick plant, etc.

Fig 8 is a map of the route between St. Louis and Chicago.

Fig. 9 is a map of the circuit showing the transformers, etc.

There certainly is a great demand for more rapid transportation at the present time, and we believe that the practical limit has been reached with steam. In the steam locomotive running, say, at 70 miles an hour, we have got with each revolution a forward and backward movement of the pistons and their connecting rods, weighing about 500 pounds on an average, which have got to be stopped and started twice with each revolution. And they have got to attain speed, running 70 miles an hour, of 35 feet per second within a tenth of a second. Of course, in order to overcome the disturbing influences of that reciprocating motion counterbalancing weights are placed upon these drivers, but it is impossible to completely counteract that.

Having disposed of the fundamental question of wear and tear of roadbed, let us look at the question of fuel for a moment. You all know that the coal or fuel item is the smallest item in a railroad system. Now, then, take a system where you can get your fuel for nothing, as will be the case with us, where we have a mine at one of the central power stations and a water power at the other central station. If our efficiency is only 10 per cent. if you choose, what does it matter?

We at once do away with the necessity for skilled engineers and skilled firemen. We have nothing but a motor man, we have no brakemen, we do not want any conductor.

As I have stated, we expect the total cost, which has been carefully estimated, will be $6,000,000, and we believe we can earn the cost of the road during the six months of the World's Fair. We have received proposals from several contractors to contract to build and equip the road in time for the World's Fair.

In the discussion which followed, Prof. George Forbes,

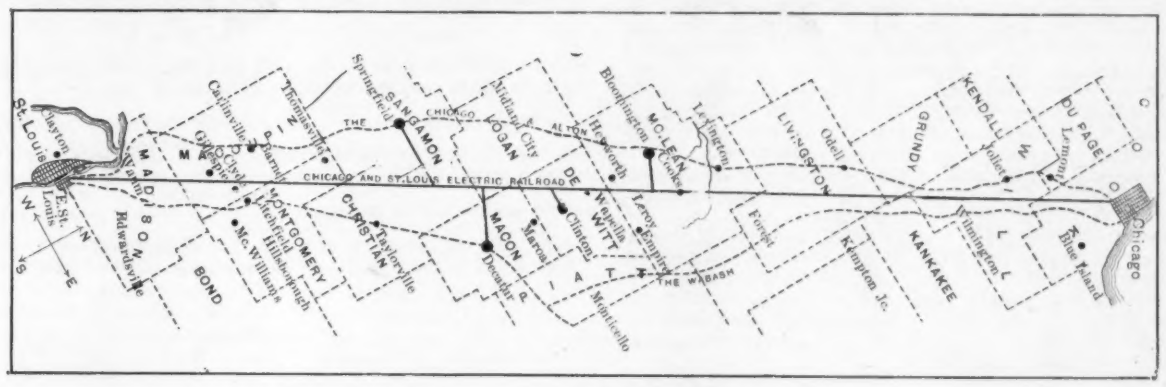


FIG. 8.—MAP OF ROUTE.

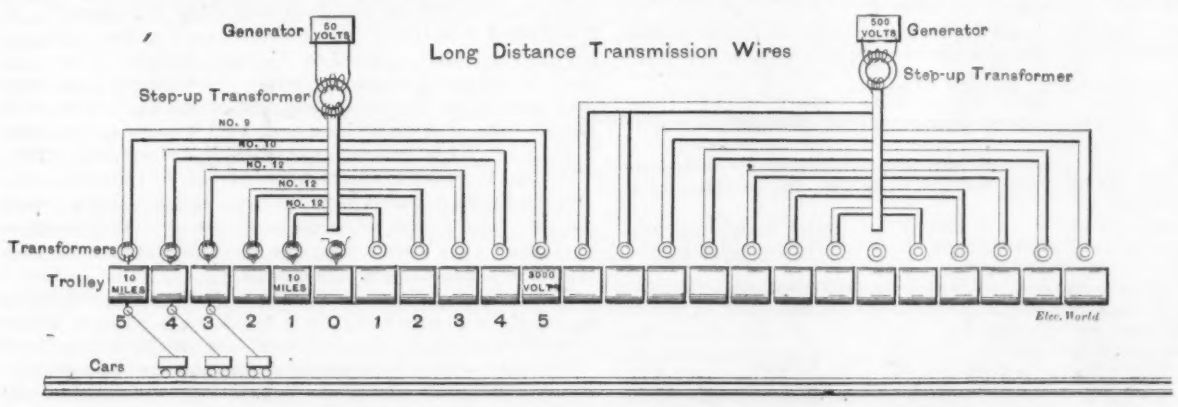


FIG. 9.—MAP OF THE CIRCUITS WITH THE TRANSFORMERS.

* See ELECTRICAL WORLD, Aug. 22, 1891, p. 126.

of London, after referring to the old-fashioned way or ordinary orthodox way of engineering a permanent way said: There is another way that has been adopted by two men in the course of the world's history, the one Dr. Wellington Adams and the other the Emperor Nicholas, of Russia (laughter). It is a simple way. You take a map and take a pencil, and you draw a straight line between two points.

It is a great feat to be able to carry this enormous power to supply a multiphase motor through a single conductor; and also it is a very great feat indeed to produce a motor which Dr. Adams has produced. I presume he has actually made tests. To produce 200 h. p. with a weight of 6,000 pounds in a motor going at 500 revolutions is a very great feat, indeed, and I am sure Dr. Adams ought to be very proud of the result.

With regard to the general question of rapid transit, which Dr. Adams has so fervently and for so long advocated, I humbly put in my claim to equal him in enthusiasm. I may say that since the year 1879 I have been hammering at the same subject.

I did not quite follow Dr. Adams in appreciating so very highly the advantages of a perfectly straight line, and yet there is one advantage which I may take this opportunity of calling attention to, because in the numerous outlines and suggestions which have been made for rapid transit, it is a point which has hitherto never been noticed so far as I know by any engineer. It is this, that when you come to the enormous speeds which we believe electric propulsion may bring us, so soon as you begin to go around sharp curves the gyroscopic action of your motors and your wheels becomes an additional factor trying to throw the engines off the line, and this force is acting in the same direction as the centrifugal force is tending to throw it over.

It is possible to have means of correcting this, and in high speed railways not having the advantages of Dr. Adams' line of a perfectly straight line such plans may have to be adopted, and I will mention one thing now that may be used for this purpose; you may have one motor above the other, both of them on the same solid framework, and both of them geared together revolving at the same rate, one driving the other, but not acting in the injurious way of ordinary spur gearing. In that case the gyroscopic action of the two, so far as it relates to the framework itself, is opposed. The gyroscopic action is confined to a pressure upon the axles of the two motors, trying to drag them, but at ordinary speeds this was enough to provide against.

FIG. 10.—VIEW OF STATION SITE AT MOUTH OF COAL PIT.

An Improved Form of Dynamometer.

BY R. O. HEINRICH.

Recent years have brought very few if any radical improvements in machinery for direct power measurements, although the complaint is very often heard from mechanical and electrical engineers that a simple and practical dynamometer is a decided want. We find the good old Prony brake as widely applied as any of the dynamometers, and now and then we come across some more or less, usually more, complicated truss construction of a cradle type; power scales also will be found to be applied to commercial tests with varied success. One generally finds that manufacturers were their own inventors, and introduced improvements in the way of automatic registers and other time-saving appliances, to one or the other of the various well-known types.

In the following article a description is given of a commercial dynamometer which has some very meritorious points. With this form of dynamometer some very good work was done at the Frankfort Electrical Exhibition last year, and it was due largely to this piece of apparatus that certain power tests of generators and electric motors of German manufacture were successfully made at that exhibition the results of which will be published at some future time

The writer has seen a number of these dynamometers in their daily operation in machine factories abroad, and was agreeably surprised to note the convenience and dispatch with which the measurements of widely different types of machines could be made with the same comparatively simple apparatus.

The credit for the design and construction of this dynamometer is due to Mr. Fischinger, chief engineer of O. L. Kummer & Co., and its construction and application is as follows :

A continuous, partly hollow shaft a (Fig. 1) runs in the journals o o_1 (Figs. 1, 2 and 3) of the frame p. The three arms d d e form one piece with the shaft and stand out from it at right angles. The smaller shaft i with the lever arm g has its one bearing in the enlarged portion of the main shaft, its upper end running on a pin of the arm d. This upper end of the shaft i carries a lever of the first class k. The two arms of the latter engage with two projections n n_1 and v v_1, cast on the inside faces of the pulleys c and c (Fig. 3). On a pin at the extreme end of arm e turns the double lever f f. A pin at the end of arm f runs in a slot g_1 of the lever arm g. The outer end of this arm g carries two threaded pins with adjusting nuts h h. To avoid sudden shocks when the dynamometer is set in motion these two adjusting nuts strike against two rubber cushions on the inside faces of the two pulleys. The arm d has a long slot in which runs the bolt m carrying a weight e'.

By a proper adjustment of this weight the centre of gravity of the whole lever system can be brought to coincidence with the centre of the main shaft a a.

A rod b runs through the centre of the hollow part of shaft a. This rod b pushes with one end against the end of lever arm f, while the other end touches the arm r of lever r r. An adjustable weight v serves to balance the weight of arm r. The lever r r turns around the pin t; the arm r, which ends in a sharp point, can move over a scale t at the lower end of the frame.

The whole system of levers is inclosed between the two movable pulleys c c_1; it is, however, very easily accessible by loosening the collar a_2 and shifting the pulley c_1 toward o.

The action of this dynamometer is as follows: The power is transmitted from the power generator by a belt to the pulley c_1 (Fig. 4), by means of the lever k k_1 to the pulley c, and from this pulley by another belt to the machine under test. The rotary motion is therefore transmitted from one pulley to the other by the lever k k_1 and shaft i. But since the two pulleys are loose on the shaft they will tend to shift their position relatively to each other. This amount of shifting is communicated by the lever k k_1 to shaft and lever arm g_1 thence to the double lever f f_1. The end of lever f f_1 pushes against the rod b, and this in turn against arm r_1 of lever r r_1. The tendency to shift between the two pulleys is therefore indicated by the index f_1 on the scale t_1.

In order to find the force which tries to turn the lever k k_1, about its fulcrum i, weights are placed in the scale pan at the end of lever arm r until the index r_1 returns to zero, in which case the system is in equilibrium. The levers have such position relative to each other that the forces transmitted through them all act perpendicularly to the arms, thus allowing the relations between them to be easily calculated. The ratio of the weights on the scale pan to the pull on the circumference of the pulley depends upon the ratio of the lever arms. This ratio is made 10 to 1; the pull on the circumference is therefore 10 times the weight in the scale pan. It must be taken into consideration, however, that in this case the weight in the scale pan will indicate the total work done, including that which it takes to run the dynamometer without a load. The weight corresponding to this latter amount of work will, of course, differ for different velocities, and can very easily be determined by throwing off the belt from the driven pulley and by balancing the system when running at the new velocity which is desired for a certain test. By making records of the different balancing weight for different velocities this can be kept in the form of a table for future references. The diagram, Fig. 5, shows the system of levers which can easily be measured with great accuracy. To determine the proper point of suspension X of the scale pan, the lengths of the different lever arms are accurately measured, and the point x found by calculation. If

P = force acting on the circumference of the driven pulley,
R = radius of the pulleys,
R_1 = equals distance of lever K from centre of shaft a,
K, g, $f f_1$, $r r_1$, lengths of respective lever arms.
W = weight on scale pan,
We will have the equations

$$P \times 2R = P_1 \times R_1$$

$$(1) \qquad P_1 = \frac{P \times 2R}{R_1}.$$

$$P_1 \times k \times f_1 \times r_1 = W \times r \times f \times g.$$

$$(2) \quad r = \frac{P_1 k f_1 r_1}{W r f g} = \frac{2 P R k f_1 r_1}{W R_1 r f g} \text{ and since } \frac{P}{W} = 10$$

$$(3) \qquad r = 2 \times 10 \frac{R}{R_1} \times \frac{k}{g} \times \frac{f_1}{f} \times \frac{r_1}{r}$$

The calculation may be checked by the arrangement shown in Fig. 6.

A brake frame is fastened on the face of the driven pulley. A projection on the brake frame pushes down the rod r when the pulley rotates in the direction indicated by the arrow. This rod presses against the platform of a decimal scale, and the pressure on the platform is counterbalanced by a weight W, which must be equal to the balancing weight on the scale pan of the dynamometer, if this is suspended in the proper point.

For a convenient calculation of the applied or consumed force in horse powers, the pulleys are given such diameters that their circumferences are expressed by even numbers.

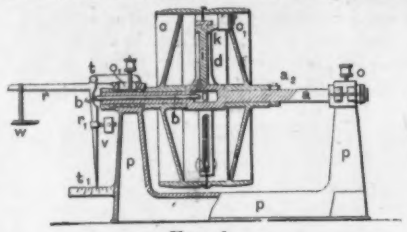


FIG. 1.

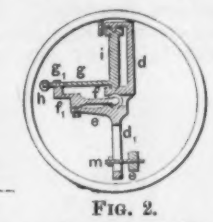


FIG. 2.

The following table gives some of the consonants of five different types of the dynamometer.

	I.	II.	III.	IV.	V.
Circumference of pulleys in metres..	1.5	2	3	3.5	4
Maximum load on scale pan in kilogr.	6.0	12.0	22.0	50.0	75.0
Maxim. number of revolutions p. m.	1,200	900	600	510	450
Maxim. number of h. p. at a circumferential velocity of 30 metres per second.....	24	48	88	200	300

The maximum capacity of any type is reached when, with the greatest number of revolutions, the scale pan carries the greatest admissible weight. For type No. 1, which with a circumference of the pulleys of 1.5 metres is built for a maximum number of revolutions of 1,200 per minute

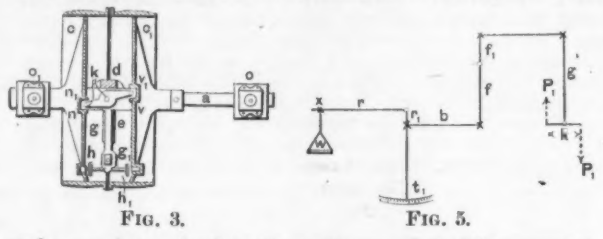


FIG. 3.

FIG. 5.

and a maximum load on the scale pan of six kilogrammes, the maximum reading would be as follows:

Velocity of the belt, $\frac{1,200 \times 1.5}{60} = 30$ metres per second.

The force acting on the circumference of the driving pulley $= 6 \times 10 = 60$ kilogrammes and the maximum horse power which can be measured: $\frac{30 \times 60}{75} = 24$ h. p. (metric).

Since the maximum reading of the dynamometer is in direct ratio to the number of revolutions, if the force act-

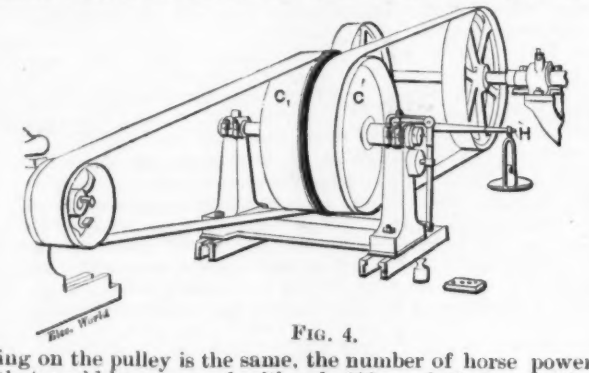


FIG. 4.

ing on the pulley is the same, the number of horse power that could be measured with only 200 revolutions per minute would be $\frac{24 \times 200}{1,200} = 4$ h. p.

The most prominent advantages of this dynamometer are the following :

The use of springs is entirely avoided, and a change of the centrifugal force cannot influence the result of the measurements.

Great sensitiveness obtained by proper balancing and minimum friction in the lever system accomplished by the use of knife-edges wherever possible.

Simplified calculations show the dynamometer is constructed on the principle of the decimal scale.

The most recommendable feature of this dynamometer is its extremely large range. *The largest model is sensitive from a fraction of a horse power up to its fullest capacity.* The following table of measurements of a dynamo made

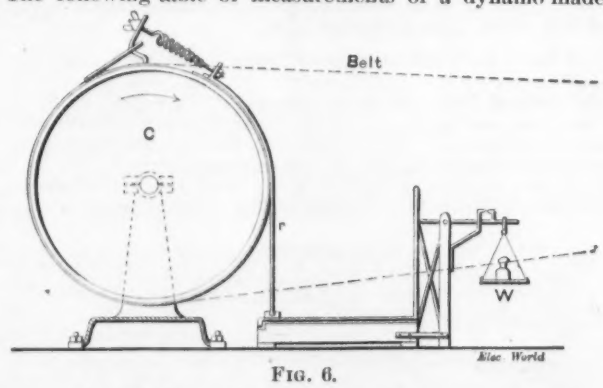


FIG. 6.

with a No. III. dynamometer (for 88 h. p. maximum) proves this conclusively.

Current strength in ampères.	E. M. F. in volts.	No. of revolutions of dynamo.	Velocity of belt per second $= v.$	Pull on belt in kilog. $= k.$	Horse power h. p. $= \frac{v. k.}{75}$
215	65	830	15.1	122	24.6
158	68.5	850	15.5	96.5	19.9
103	70.5	870	15.75	71.0	14 9
31	74.0	875	16.1	34.5	7.4
0	75.0	885	16.25	17.5	3.8
0	2.5	890	16.25	6	1.3
215	63.0	840	15.75	14.2	29.5
0	67.0	835	15 25	14.5	2.95

Automatic registering devices may easily be combined with the dynamometer, making it a still more useful piece of apparatus for the every day routine work of machine shops and dynamo factories, all of which combined with the other prominent advantages should make the dynamometer a desirable adjunct for every factory or laboratory where power tests are of frequent occurrence.

Some Points for the Electrical Engineer.*

BY HORATIO A. FOSTER.

Although it is the province of this Institute to consider largely the more theoretical side of electrical engineering, and rightly so, it is perhaps well that it should occasionally have brought to its attention that outside practical part, only for which theory would have no backing, and therefore could not reach its proper development.

It has been the fortune of the writer during the last ten months to visit and inspect, both technically and financially, considerably more than a hundred central lighting stations.

Taken as a whole, it really seems as if much of the ordinary commercial common sense and the usual keen judgment of self-interest had been on a vacation when these plants were erected. In many cases this traces back—first, to the wiles of that slickest of all individuals, the agent, who is always willing to assure the buyers that his system of lighting will virtually run itself, and then to the fact that people were formerly so doubtful of the prospective profits that on going into the business they invested the smallest amount that would start the work. The consequence was, bad construction, bad machinery, bad lines, and, of course, an entirely unreliable service. Oftentimes the man put in charge was a novice, and that worst of all novices for the business, the local amateur electrician; and is it any wonder that the business was a failure for the first few years?

In some localities this condition still obtains, nothing having been done but to patch up the bad work of the past.

In a few cases the administration has been changed by putting at the head some substantial and tried business man, very much to the benefit of the concern. While, in many instances, even the large city plants suffer from the above causes, they also suffer from other conditions inherent in the size of their field.

The pioneers were so timid about the outcome, that the city station was invariably very much too small, and inside of two years had become so patched up and crowded that rebuilding became necessary, and this in many cases was repeated two or three times.

There is probably no business extant which has been built over so many times and that has had the same quality and quantity of brains applied to it that is in such chaos as to the proper design of building and arrangement of machinery. In cotton or any other weaving industry, machine shops foundries and similar establishments, it has long been determined which is the best form of building to erect, and those put up in the last ten years or so of a similar industry are planned on the same lines, differing only in size to suit the special case. Now, this not only fails to be the case in electric lighting, but outside of the two prominent systems of connecting the dynamo to its power—that is, by direct belting to fast running engines, or by counter shaft to larger slow running engines, there are scarcely a half dozen stations in the state built on the same or similar lines.

So much diversity of opinion is shown in designing these stations, and oftentimes by those whose opinion should have no weight, but unfortunately does, that it has the effect to convince some of the investing public that the electrical engineer does not know his business and they might as well go it alone.

If some action could be taken by this Institute through a committee which should examine into proper station design and report on some few general plans and suggestions as to lines to be followed, it might go far toward establishing a better backing for our members who are in that branch. As it is I think it will be acknowledged that far more electrical engineering skill is applied to the larger isolated plants; and that the central stations are enlarged or rebuilt under the management of the local superintendent or board of directors, who frequently lack technical knowledge or even familiarity with recent improvements elsewhere. Quite often this is owing to the fact that the only experience they have had with an electrician has been the generally young, inexperienced expert who was sent out to install the first plant, and they think they can make better use of their money by controlling it themselves.

The method of distribution should also have consideration, especially in reference to the amount and style of underground work which certain sizes of city will be able to stand.

This may seem a large question, but you can be assured it is one of the most vital to the future welfare of the industry. It may be said that it is not well to interfere in private business, and that electrical engineers can be trusted to remedy the evil. I assure you the electrical engineer individually "is not in it," to use a vulgar phrase, and, sad to say, has never been in it to any extent. Quite often officials of the electric lighting companies take a jaunt through the country visiting different stations for models for a new one for themselves. This often results in a worse muddle than ever, as they seldom find two stations at all similar, and they return resolved to use their own judgment.

This leaves the real electrical engineer out in the cold, at a point where if known he could by consultation do much good; but many of these company officials never heard of the American Institute of Electrical Engineers and need to have it brought to their notice in some way.

Some may think that in time the electrical engineer will be called in and consulted, as are engineers of other works, but at the present rate I am afraid many will be angels or worse before the majority of electrical central station companies come to that point.

Perhaps if instances be mentioned under the following heads a better understanding can be arrived at, viz.: Location; foundations; construction of station; motive power; arrangement of machinery, and location and construction of lines.

LOCATION.

The location of plants is not now so generally bad as in the past, although we occasionally find a station in a location for which no excuse is apparent, as, for instance, one located in the basement of a carpenter shop at a long distance from fuel supplies, and only plenty of condensing water to recommend it; insurance rate, three per cent. or more. Another

* A paper read before the American Institute of Electrical Engineers.

located nine miles away from a village of two thousand people to take advantage of water power never surely available all the year, and since destroyed entirely for the greater part of the year. Another placed so low down in reference to its water power as to be flooded in freshets. Another located more than a mile from fuel supplies, and the centre of distribution at the top of a long, steep hill, with not even free water to recommend it. Another so located in relation to a very intermittent water power as to be unable to take advantage of the water for condensing purposes and now running the poorest kind of a slide-valve engine. Another located in a rickety, old, uncared-for part of a gas house where coke is scarce, and apparently plenty of water power available within half a mile.

Another located a long distance from centre of distribution and coal supplies, to take advantage of cheap land and cheap fuel, the last of which has since proved very unreliable, when seemingly land could have been had much more central, with a much surer supply of cheap fuel, and, to cap all, the value of that land has since increased enough to have paid the entire cost of the station at any moment it be desirable to sell.

One advantage of some of the older centrally located stations has since been learned in the increase in value of such real estate. One such station visited will enlarge and rebuild soon, and will sell its present real estate for enough advance to go far toward paying for the new station, and there are others which can, I think, tell the same story. In fact, in the present problematical growth of the future, a well selected piece of ground may prove a very valuable part of the investment.

FOUNDATIONS.

Foundations are now much better than in the past, and some of those now placed under dynamos would sustain almost anything that could be put on them. Poor foundations are occasionally seen though, as for instance those under a large bank of boilers in a station which was erected and started in six weeks. The boilers have since lurched forward until the fronts are some two or three inches out of plumb. In fact too little attention seems to have been paid to boiler foundations as a general thing.

Engines have fared better, and when the ground has been good the foundations are to be little criticised.

One station has very large Corliss engines, and owing to water-soaked ground and limited time in which to build the brick foundations, they were placed wholly above the floor level of the dynamo room, and belts run both ways from the fly-wheels to shafting on either side of the room.

Very few bad dynamo foundations are now met, but many unbalanced armatures are found which no amount of foundation would hold steady.

STATION CONSTRUCTION.

In station construction there has been no settled design, therefore the promoters have generally built as they saw fit, occasionally following suggestions of the agent. Of course many plants are located in buildings already up, in which case the machinery had to be made to fit.

In many of those built especially for the work, no attention has been paid to designing for a low insurance rate, and brick stations are found sheathed all over the inside with pine, the one thing that insurance inspectors always criticise. A couple of coatings of whitewash or paint would have been much cheaper, safer and looked quite as well.

When stations have been remodeled very little improvement has been made in the smaller ones, but those in large cities have generally taken advantage of all the improvements to date, if not too strongly attached to some one parent company.

MOTIVE POWER.

The selection of motive power has of course been governed by local conditions; in the northern and northwestern parts of New York State water power is abundant and is largely used as motive power for stations, but almost invariably with steam reserve.

Water power alone has been found very difficult to govern for uniform speed, and some of the devices used for that purpose are, to say the least, ingenious.

When the load is large enough to use part steam there is no trouble whatever, as the wheel takes a steady load and the engine does the governing.

Plants are sometimes placed a long way from the work in order to take advantage of water power, and in some cases it seems as if all else had been sacrificed to that one point.

Of engines there is no end to the different design, style and size used. Some use high speed, belted direct to dynamos, others slow speed belted to countershafts, some simple non-condensing, where compound condensing would be decidedly best.

I know of at least three plants located in water-works pumping stations using high-speed simple non-condensing engines on a practically steady load, all of which have been erected during the past three or four years.

Two stations I remember having an all night and every night load of arc lights, and situated on a lake shore, which run high-speed simple non-con densing engines.

To offset this there is one station that deserves mention, as it embodies many points of value. The building is substantial, of brick, two stories high and on a river bank. The boilers are very efficient and well set, the engine is a moderate speed compound condensing, with shaft extended for three dynamo pulleys, and one for the power condenser. There is a heater between the exhaust and condenser, and a power pump attached to one side of the condenser. The flow to the boilers is governed by a by-pass valve, as the pump is of course in motion all the time the engine is running. This station has only an arc load and runs all night; it was built entirely under the supervision of a local mechanical engineer, with the exception of connecting the lines and dynamo terminals to the switchboard, and would, I think, be hard to beat for results.

ARRANGEMENT OF MACHINERY.

The arrangement of machinery is as diverse as the style of motive power; when direct belting is used the arrangement is generally simple and plain, but oftentimes so crowded as to be very inconvenient.

There seems no end to the arrangement of shafting; some have a line shaft through the middle of the dynamo room, and belt both ways to dynamos; others a shaft on either side of the room, belting to dynamos in the centre; others the shaft under the floor, belting up to dynamos, and occasionally to engines also; others have the shafting overhead; in fact, there is no end to the styles, some good and some bad. In most cases friction clutches are used with shafting for stopping individual dynamos, and some few may use loose pulleys on independent sleeve for the same purpose.

The length of belt centres varies greatly, some apparently thinking if long belts are better than short, very long ones must be much the best.

The improvement in switchboards seems to me more marked than in any other one department, which is probably owing to the pressure of insurance men, who look at the switchboard as the most dangerous fire risk of all.

LINE CONSTRUCTION.

In line construction I cannot see that any very marked improvement has been made, excepting, in some cases, the substitution of larger and better poles for the older ones.

The use of black covered wire in place of white has, perhaps, made the lines a trifle less conspicuous; but that is about all. The lines still have the apparent aimlessness of direction mentioned by Prof. Thomson at Buffalo.

People in the larger interior cities are already agitating the question of underground wires, and it seems probable that unless something is done soon by the companies themselves to rid the streets of the more conspicuous of these wires, there will be very costly trouble for them to contend with.

It can no longer be denied that wires are working well every day in subways, and the only valid argument against them is extreme cost. Nevertheless, when the general public learns this fact, cost will have little to do with the argument.

In many places wires can be removed from the main streets to alleys back of the shops, and the extra cost will be decidedly cheaper than underground work. In such few places as have already done this wires are inconspicuous and the underground question is never raised.

In street lighting the favorite method is the cable suspension across the street. Where the work is neatly done this serves very well, but it would be difficult to find a more unsightly thing than some of the lamps so suspended.

Considerable trouble is occasioned in the above method by breakage of the wires at the joint with the line and at the cross bar over the hood. There is no apparent reason why twin or duplex wire should not be more used for this purpose, instead of the kinked and straggly single wires.

There are many other methods, some of them good in principle but bad in the application, and so it goes.

It seems to me that if some action was taken by a non-partisan association like this Institute, an advance toward better engineering might be made, if a few general laws could be suggested to be followed in laying out the different parts of a lighting station. Perhaps it may be said that much of the above work should more properly come before the National Electric Light Association, but as many of that society are members of this Institute, I feel sure they would individually appreciate its backing in the future when the time comes for enlargement, and they have need of combined expert opinion.

Selective or Individual Signals.*

BY THOMAS D. LOCKWOOD.

Among the many subordinate branches of invention in auxiliary appliances which surround and form a suitable setting for that grand central figure, the Electric Speaking Telephone, none represents more painstaking thought, has been more thoroughly ransacked, or has constituted a more attractive pursuit than the study of selective signaling.

The problem it presents is both electrical and mechanical, is sufficiently difficult to create the excitement always attending the pleasures of the chase, and sufficiently promising and hopeful of a practically successful issue to be retentively fascinating. Hence its solution has been attempted alike by prominent and capable electricians, by practiced electro-mechanicians and by amateurs; has, from the laboratory and workshop point of view, already many times been achieved in as many different ways, although commercially it yet hangs like the fabled bundle of hay, just a little in advance of the enthusiastic aspirant who strives to clutch it.

THE USE OR FUNCTION OF SELECTIVE SIGNALS IN TELEPHONY.

The business of the average user of the telephone keeps a line employed but for a very small part of the entire business day, and for the remainder of the time the line wire is idle and earning absolutely nothing. If by any means it could be made possible to place several sub-stations in connection with the same circuit, without materially affecting the efficiency of the service rendered, it is obvious that the earning power of the circuit would be largely increased. But a call bell or other signal is clearly necessary in order that the attention of the station may be attracted when some other station desires to communicate, and as we add stations to a circuit we also add necessary call bells, thus introducing two practical objections, viz.:

1. A most incessant and annoying ringing, because a call sent to any station is heard at all stations.

2. The necessity of distinctive signals, whereby when the bell at any station is rung the attendant may know whether the call is for his or for some other station.

At this juncture the selective signal steps in, and its special work or function may be thus stated: That two or more stations being electrically connected with the same circuit, the call bell at any predetermined or desired one of such stations may be operated, and the call given there, to the exclusion of the call bells at the other stations, which at the same time remain quiescent, or are silent. We therefore see that the thing to be done is not merely to ring a bell over an electrical circuit; but to select and ring from a distant point a *given* bell on a circuit with which more than one is connected; and at the same time to insure that the bells at the other stations, which are not intended to be rung, shall not be rung.

This statement of function justifies the term "selective signal" which I have adopted, and which I conceive to be more appropriate than the old term "individual signal" is because more descriptive.

*A paper read before the American Institute of Electrical Engineers.

HISTORICAL SKETCH OF SELECTIVE SIGNALS.

The idea of producing a practical selective signal is not (as might from the introductory remarks of this paper have been supposed) one which made its first appearance subsequent to the advent of the telephone.

Appliances possessing the same characteristics appeared in England many years ago, and several forms have from time to time been patented in that country for use in connection with telegraphy which closely resemble some of the forms which, within the last ten or twelve years, have been reinvented and patented here.

One of these* is based upon combinations of a plurality of line wires, two or more of which extend from a terminal to each two sub-stations.

A second† involves two wires together with the use of both directions and varying strengths of current; and states itself to be "for sounding any particular alarm in a set of telegraph stations."

The third,‡ quoting from the published abstract, is for "transmitting secret intelligence to any one or more stations without the use of extra wires. At each station a metallic disc, suitably inlaid with non-conducting portions, is brought to the required position in order to complete the circuit or not, by any electro-magnetic step-by-step movement, thus excluding or including the telegraph instrument at any particular station or set of stations as required."

Three other British patents prior to 1876 are of this class, one of which§ speaks of "an apparatus comprising a main line, a series of independent branch or station lines at each end, and clocks at both ends working synchronously, which, by means of revolving cams, place the main wire in consecutive connection with corresponding branches at the two ends for definite times."

Another‖ speaks of "apparatus placed in a continuous circuit; the bell at any particular station being caused to ring by the simultaneous advance in all the line wire apparatus of a cam disposed in a way peculiar to each station, which is instrumental in closing a local circuit by which the bell is sounded."

The final instance¶ of this series is a mechanism in which a disc slotted or perforated at but one point, the location of such point differing for each station, opposes itself to the forward motion of an armature lever at all times, except when the slot or hole is immediately opposite a pin on the end of the lever. This occurs at no two stations at the same moment, but when it does occur at any station the pin passes into the slot and the armature is thereby permitted to complete its advance and to close a local circuit and ring a bell.

Several of these suggestions will no doubt be recognized as being found also in some of the more modern selective signal appliances.

In France, too, in connection with railway telegraphy, this class of invention was formerly very popular; and, as might be expected, is not neglected by that indefatigable chronicler, the late Count du Moncel, who devotes considerable space to the subject in the "Expose des Applications de L'Electricité."**

It is unnecessary to recapitulate much of what he states, and it is perhaps sufficient to say that the plans of no less than thirteen different inventors are described, in which the achievements of selective signaling is at least aimed at; and that some of them evince as thorough an appreciation of the merits of the question as do many of the appliances patented for the same purpose in America since 1876, while one or two actually are based upon ideas which are found in comparatively recent patents also.

In the plan of Lamothe, for example, which is discussed by M. du Moncel, the gong which is to be struck is by one electromagnet brought within range of a bell hammer, which then by a second electromagnet is caused to strike the bell.

Another inventor, Bizot, has a plan for selectively ringing bells by means of pendulum hammers placed at the different stations, and adjusted at each station to a different length.

An electromagnet at each station in the main circuit controls the swing of the pendulums by its alternate magnetizations and demagnetizations brought about by the makes and breaks of the main line current; these being effected by a vibratory circuit breaker at the transmitting station, operated by a similar electromagnetic pendulum there, which can be adjusted when desired to the same length as the pendulum at any one of the other stations which it is desired to operate. Only that one to which it is adjusted will be operated, the others remaining inert. By so arranging *all* of the station pendulums that they can be adjusted, any station is enabled to selectively signal any other.

This apparatus I have described at considerable length, because it is founded on the harmonic principle which later was introduced into telegraphy, and because it contemplates the use in selective signaling of that principle, subsequently more elaborately worked out by German and American inventors and described in their several patents.††

Martorey's system, which likewise is described by M. du Moncel, also contains the elements of many subsequent forms. In it, by an electro magnetic step-by-step motion, an escapement wheel having a number of teeth at least equal to the number of stations on the circuit, to give the signal, is brought to a given position by a given number of pulsations, differing for each station. All the teeth are metallic, and all, except one, are insulated. That one connects with the axis and mechanism, and is part of the alarm circuit. When brought into position, the ringing circuit, which it appears is open normally at two points, is closed at one of these points, and at this juncture a single impulse sent over a second wire closes the second break in the local circuit, causing the bell to ring.

* Br. patent 12,039, January 25, 1848, H. and E. Highton.
† Br. patent 12,959, Feb. 7, 1850, E. Highton.
‡ Br. patent 13,427, Dec. 27, 1850, Dering.
§ Br. patent 3,006, Dec. 1, 1863, Wilde.
‖ Br. patent 910, March 31, 1865, De Bonneville.
¶ Br. patent 1,801, June 11, 1869, Lyttle.
** "Expose des Applications de L'Electricité," vol. III., 1874, pp. 510-528.
†† German patent 1,944, Maron, Dec. 5, 1877. Br. patent 5,078, Blake, Dec. 11, 1873. U. S. patent 251,097, Currier, Dec. 20, 1881, and others.

In addition to the foregoing examples of the condition of the art, it is not, I conceive, out of order to point out that the principles which govern printing telegraphy are closely related also to selective signaling. Consider, for example, the House, Hughes and Phelps telegraphs, and the form of stock quotation recorders, now so universally employed; in all of these a given letter or figure is brought to a suitable point, and is then pressed by a final operation against the paper to make the impression.

Now a little careful thought will show that the two problems—

A. To bring a number of typewheels at different stations all to the same predetermined point, and then press the paper against them so that the same letter will be printed at all stations, and

B. To bring a number of wheels at different stations carrying local circuit closing devices (placed at a different point for each wheel) all to the same predetermined point, where any particular one of them will be in position to close its local, and ring its bell when the press movement is made—are not in principle by any means far distant from each other.

They are further related in that both must have a unison, zero or starting point, to which they can be brought periodically for a fresh start, to forestall a lack of harmony between the different stations, or to provide means for bringing back an errant wheel which has strayed away from the path of electro mechanical rectitude.

A good stock of knowledge thus was at the disposal of those interested, even at as early a date as 1876, when the career of the telephone was only beginning. We had the electro-magnetic ratchet and pawl, step-by-step movement. We had electrically controlled clock trains.

It was old to trip clockwork electrically, and also to use wheel circuit changers. The unison device in connection with step-by-step devices was old, and its use well known; the relay and its function of closing local alarm circuits was already a classic; wire combinations of various sorts were customarily employed, and the harmonic field had already been well threshed by Helmholtz, Bizot, La Cour, Varley, Gray, Bell, and others.

Why, then, was it not easy to make at once a thoroughly satisfactory and efficient selective call?

One reason is, that the average inventor or would-be inventor generally refuses, tacitly it is true, to recognize that there is any material of which he may make use. He does not know the state of the art; does not want to know the prior art; does not care anything about the prior art, and

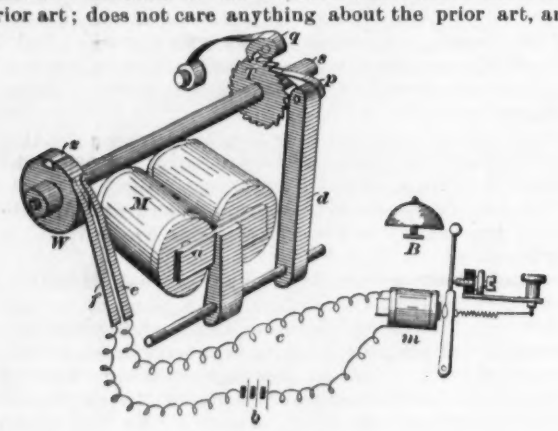


Fig. 1.

often feels affronted when he is necessarily brought face to face with it; and then he gives utterance to the pathetic plaint "that the people of former times were a dishonest race, they have stolen all my new inventions."

It is, however, clear from what has been stated, that the principles which underlie the problem in its many phases had to a great extent been elucidated, and that much had been done in working out scores of electro-mechanical contrivances, capable of being utilized in apparatus embodying such principles; and for these reasons there has in this branch of electro-mechanics been little scope for the exercise of original broad invention, and consequently little reasonable expectation of substantial pecuniary reward, even for him who might produce a thorough practical success in selective signaling.

These considerations have without doubt had effect in preventing many inventors and mechanicians of the first rank or of great experience from vigorously grappling with what was left of the problem. Yet from January, 1879, to December, 1891, 161 United States patents were granted for forms of telephonic selective signaling appliances, all of which I have examined.

A careful analysis shows that quite a large number of general plans have been proposed, and that each of these has been developed in several ways, with greater or less care, and to many degrees of perfection. Several sub-methods can be utilized in many of the general plans, and in a number of cases attempt has been made to provide for several additional functions.

Though at one or two points selective signals, embodying a few of these different plans, are even yet employed, every telephone man knows that it cannot truly be asserted that success has attended such appliances.

One reason why, has been detailed. Some other reasons may now be given.

1. Some forms of promising selective apparatus have been put into use before being mechanically perfected, and their faultiness has given a figurative black eye to the entire race.

2. Some have been inherently defective, either in principle or construction.

3. Many as soon as crudely devised have been employed as beasts of burden on which to organize a heavily capitalized stock company, and it has therefore been the great object of the advocates of these to sell stock, instead of to make a practically successful apparatus.

4. To be commercially successful, a selective signal for a telephone system must be of low cost. In every form which has been put out and which has come under my observation, this requirement has been too prominently insisted upon, and the attempt has been made first of all to make not merely a *low priced*, but a really *cheap* signal. This attempt, I may note, *en passant*, has met with uniform success.

5. Excellence has not been insisted upon.

6. In many instances the apparatus has been required to do too much, or to perform too many functions, and has therefore become complicated; and

7. Usually the places where such signals have been tried have also been places where intelligent supervision has been at a minimum.

Under the above circumstances good results need not have

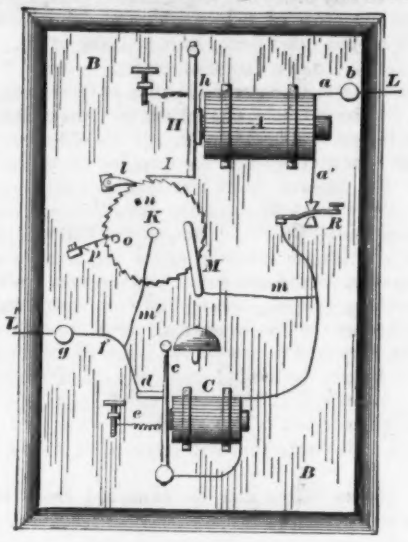


Fig. 2.

been expected, and although they were expected they did not arrive; and the user, after trying successively many of the different kinds of signals from time to time placed before him, has, with the few exceptions already noted, discarded all, and for a long time now has refused to listen further to the voice of the charmer, alleging, and with some show of reason, that "the only trustworthy individual signal is an individual line."

DESIRABILITY OF SELECTIVE SIGNALS.

This epigrammatic saying is, however, in some sort losing its attractiveness in face of the multitude of conductors which it implies; and to a keen observer of the signs of the telephonic times, it is evident that a very extensive return to party lines in some form will by and by be inevitable, at all events for residential districts, and from this point of view it appears that the demand for a simple and trustworthy, but not costly, selective signal is as great as ever and that, if such a thing is made, and its merits proved, many more party lines could and would be arranged and satisfactorily operated.

To reach practical success, by which is meant to devise a really trustworthy selective signal, economical, simple and easily kept in order, invention is not so much needed—keeping the prior art in mind—as is electro-mechanical skill to mold a homogeneous and perfect apparatus from the immense amount of material we have to choose from; an apparatus, in fact, which will operate perfectly, not only when the several circuit signals are ranged up alongside each other on the testing room wall, where a screw may be adjusted here, a spring tightened there, and a bell hammer rod bent in another place; but equally well when they are distributed over the circuit, and all at a distance from the operator.

And to aid the adventurer who intends to construct such an apparatus, I will outline the principles upon which this class of work in its several proposed plans have so far been founded, reference being made in brackets to a single United States patent exemplifying each of the several plans.

GENERAL PLANS.

1. To operate the several signals at each sub-station on a circuit with differing strengths of current.

Bells depending for their proper operation on a margin of current are however generally untrustworthy. [U. S. patent No. 221,512, Nov. 11, 1879, Buell.]

2. Signals arranged to respond to currents of opposed direction.

This implies of course polarized bells, and for a line with but two stations it is probably as good an arrangement as can be provided. [U. S. patent No. 218,153, Aug. 5, 1879, Anders.]

3. Signals involving changes both in strength and direction of currents.

These are apt to be unreliable for the same reason as are those of No. 1. [Patent No. 242,408, May 31, 1881, Anders and Vail.]

4. Electro-magnetic step-by-step devices, acting to bring

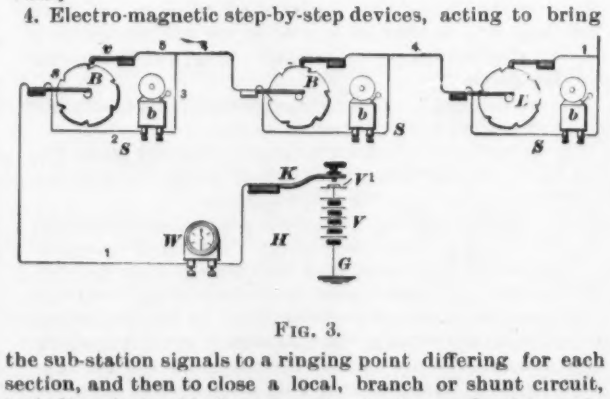


Fig. 3.

the sub-station signals to a ringing point differing for each section, and then to close a local, branch or shunt circuit, including the local bell, to operate ringing mechanism, or in some way to introduce the bell magnet into the circuit.

Fig. 1, taken from a patent of E. N. Dickerson Jr., illustrates a ratchet and pawl step-by-step movement operating to close a local circuit in which is placed the bell. Successive pulsations sent from the central station cause the electro-magnet *M* in the main line circuit to attract its armature *a*, which after each pulsation is pulled back by a suitable spring not shown).

The non-conducting wheel *W*, on which presses the two springs *e* and *f*, has at one point on its periphery an inlaid piece of metal, *z*. When the wheel is rotated till the plate *z* comes under the two springs, the local circuit of the battery *b* is closed through the bell magnet *m*, and the bell *B*, which in practice would be vibratory, rings.

The wheel *W* can be adjusted on its shaft *s*, so as to be in a different position at each station, and is operated by the main magnet through its armature *a*, lever *d*, pawl *p*, and ratchet wheel *r*, the retaining pawl *q* holding the shaft *s* between the several forward impulses.

There are of course many other ways of utilizing these principles, one being shown in Fig. 2, which is one of the drawings of a patent taken out by Messrs. Curtis and Crocker.

In it the main line *L* comes to the binding screw *b*, passes by the wire *a* to the main electro-magnet *A*, which acts through its armature *h*, lever *H*, and pawl *I* on ratchet wheel *K*, held at any point by the retaining pawl *l*, and provided with a zero spring *p* and stop *o*. The ratchet wheels *K* are metal and at a point on their disc surfaces, differing for each station, have a non conducting piece *n* let in, flush with the said surface.

A contact spring *M* presses also on the conducting surface. After passing the magnet *A*, and continuing by wire *a'* to a key *R*, used to call the central station, the circuit divides, one branch passing through the magnet *C* of the call bell and thence by way of the bell hammer level *c*, back contact *d*, and point *f*, to the terminal *g* and thence to the outgoing line *L'*.

The second branch passes by wire *m* from the point of division to the contact spring *M*, thence to the ratchet wheel and through the mechanism and by the wire *m'* to the reuniting point *f*, binding screw *g* and outgoing line. Thus as long as the contact spring *M* presses on the metal face of the ratchet wheel the bell magnet is short-circuited; but when, as the wheel is revolved, the end of the spring presses on the non-conducting piece *n*, the shunt circuit is broken and the bell introduced and rung.

This general plan No. 4 has been much favored by inventors, admits of almost indefinite variation, and is easily associated with auxiliary devices such as unisons, busy signals and lock-outs for apparatus at other stations. If mechanism properly designed and made be employed, there

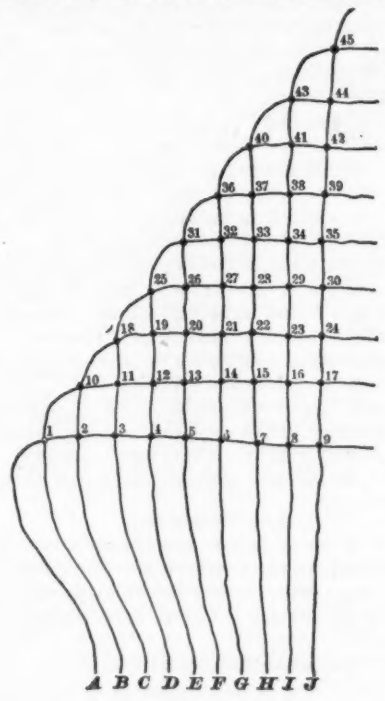


Fig. 4.

is no reason why satisfactory results might not be expected. Cheap apparatus has, however, invariably been tried, and the system besides is slow. [No. 212,792, March 4, 1879, E. N. Dickerson, Jr. No. 230,530, July 27, 1880, Curtis and Crocker.]

5. Clockwork bells.

a. Those in which a constantly running clock train brings the bells at the different stations into circuit successively, or removes a mechanical holder from their hammers, when only they can be rung. These are not reliable, it being impossible to keep the clocks together. The clocks also require too frequent winding. [Patent 223,469, Jan. 13, 1880, Bliss.]

b. Those in which at each station is a normally stopped clock train. All clocks are started by the same initial pulsation, and bring their signals to ringing points, or their bells into circuit at different times.

This idea is one of the most practical that has been advanced, and if the apparatus is well designed and put together in a good mechanical form, it ought to do good work; unfortunately, first-class apparatus is costly enough to remove the gilt from the economical side of the selective signal.

This plan is indicated by the diagram, Fig. 3, in which however the clockwork is not shown. In the diagram *H* is supposed to be the signal transmitting and *S* the signal receiving station, at each of which is a metal circuit wheel *B*, by which in conjunction with the circuit springs *s* and *v* the bells *b* are when at rest short-circuited. At the transmitting station is a circuit closing key *K*, a battery *V* having one pole united to earth or return *G* and the other extended to the front contact *V'* of the key, and a duplicate *W* of the several sub-station instruments.

The first pressure of the key through suitable mechanism starts the clockworks at all stations, and introduces the bells at each station successively, as the wheels *B* bring their notches under the springs *v*. The wheels are in the present instance supposed to be slow moving, and to have six ringing notches for each complete revolution. They can by suitable mechanism be stopped on each notch to ring a given

bell as long as may be desired; and they come to rest after one notch at all stations has passed under its spring.

Of course the notches are arranged to pass under the springs at different times for the several stations, and this is indicated in the figure, where the bell at the nearest station is introduced into the circuit, the springs v of the others being at different positions on the periphery of the wheel. [Patent 232,442, Sept. 21, 1880, Blake.]

c. Those in which a normally quiescent clock train is controlled by an electro-magnetic escapement, and permitted to move by successive beats, as a key at the central station alternately makes and breaks the circuit. [Patent 228,047, May 25, 1880, Eaton.]

This could doubtless be made to work all right by putting excellent apparatus into it, but like nearly all step-by-step devices would generally be slow.

NOTE.—All of the subdivisions of class 5 may either have the signaling device directly in the main circuit or in a local circuit to be closed by the action of the main circuit.

6. Bells in which all the hammers move forward to strike at the same time, but except the desired one are prevented from striking by an interposed mechanical obstacle, which in the bell of the wanted station is removed.

This has been faithfully tried. It was operated by an electro-magnetic ratchet and pawl, and was uncertain in operation. It also developed another fault, viz., that even the bells which are not to respond make a considerable rattling. [Patent No. 219,059, Sept. 2, 1879, Anders.]

7. Bells in which the ringing is done by circuit arrangement, or conductor combinations. Two series of circuits may radiate from a central to a number of sub-stations, and one of each series caused to enter all stations. No two stations, however, have the same two circuits. Only when the

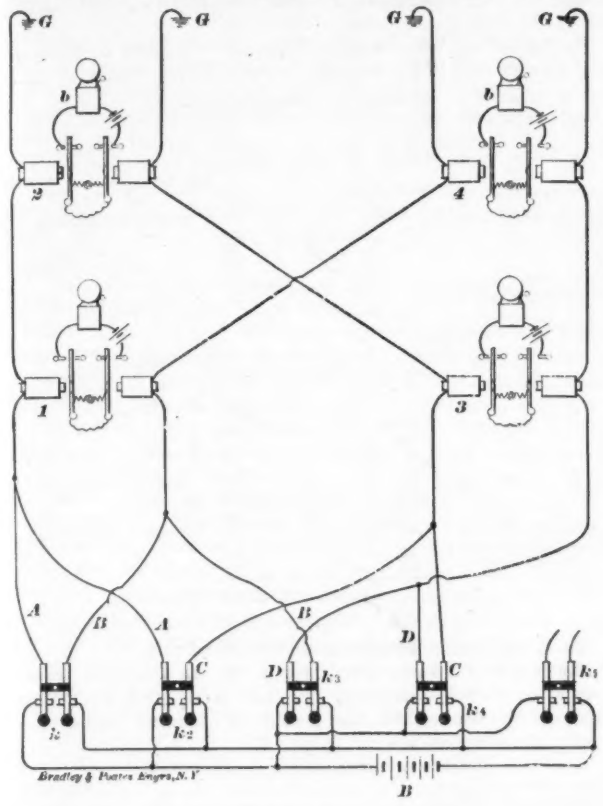


FIG. 5.

current traverses both circuits does the bell ring at the station they enter.

This is very promising. It cannot, however, be applied to a multiple switchboard system. It requires relays and a local circuit bell, but no specially constructed apparatus.

It is also very speedy, the single pressure of a given key will always ring a given bell and no mistake can be made.

This system is roughly illustrated by the diagram, Fig. 4, in which each outgoing conductor is shown to intersect each other conductor at some one sub-station, and thus afford facilities for producing a selective signal for 45 stations by using but 10 main lines.

For example, if it be desired to signal station 41, it will be necessary to manipulate the lines G and I.

The diagram, Fig. 5, more fully illustrates one way in which the idea is worked out, although there are several plans, all of which are more or less advantageous.

A battery B branches its two poles to each of a series of keys k, each of which controls the terminals of two lines; for example, key k may control terminals of A and B, k^2 those of A and C, and so on.

At each sub-station two lines both enter and pass respectively through relays, and the concurrent action of the two relays at any station is required to ring the bell, since the bell circuit is led through the armature levers and their front contacts of both.

Taking the conductors in pairs, the number of possible combinations is represented by the expression $\frac{n^2 - n}{2}$ and that number of separate stations can be selectively signaled by the use of n wires. [Patent No. 219,188, Sept. 2, 1879, Vail; Patent No. 224,855, Feb. 24, 1880, Vail.]

8. Bells working on the principles of harmonic telegraphy. At each station the spring, pendulum or reed carrying the bell hammer is tuned to respond to a different note or rate of vibration.

The central station transmitting device is adjustable, and can have its rate made to correspond with that of any sub-station bell. When set in operation the coinciding bell only will ring.

Operated always by experts, and carefully constructed and adjusted, these might do well. They are, however, too sensitive, tend to become operative as their proper number of vibrations is approached, and in some degree become irregular with temperature changes.

Fig. 6 illustrates the idea, and shows a central and three sub-stations.

At the central station is a battery, z, and three pendulum circuit breakers formed into a single apparatus, x'. Each breaks and makes the circuit at a different rate of speed.

The main circuit passes through the magnet A of the different sub-stations successively, each magnet having a reed armature to which a pendulous bell hammer is attached, the normal rate of vibration thereof corresponding to that of some one of the transmitting circuit breakers. At the end

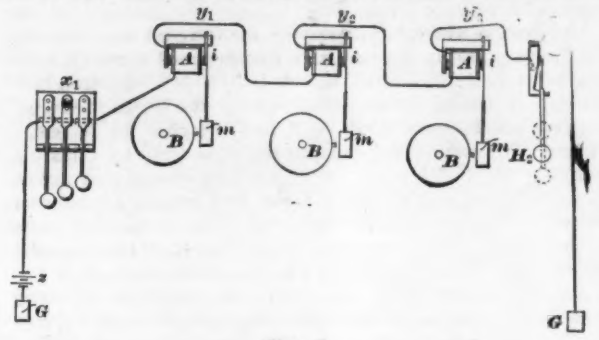


FIG. 6.

of the circuit is shown a second transmitter, x^2, with which, if desired, the sub-stations may be provided.

It has an adjustable pendulum bob, H^3, which can be moved to correspond with that of any bell which it is desired to ring, and which, then being set in vibration, is responded to by such bell. [Patent No. 251,097, Dec. 20, 1881, Currier.]

9. Sub-station signals in which galvanometers identically constructed and calibrated make the same deflection with a given current; to ring the bells different currents are sent, which produce different deflections. Each, of course, has its ringing deflection at a different point, which may by a mercury cup close a local circuit.

These signals ought to work fairly well if sufficient care and cost be put into them. It would not be difficult to add several other classes to this list, but those which have been mentioned are the most important. [Patent No. 262,252, Aug. 8, 1882, Southworth.]

The plans of greatest promise are:

A. Those which by clockwork (as in 5*b*) are brought to a ringing point differing for each, the clockwork being then stopped, and the ringing done by a different kind of current. This is virtually the same plan of operation as is employed in the stock quotation printing telegraphs, and is reliable, but when adapted to do the work well, costly.

B. Those which, as in class 7, require the co-action of two circuits.

Either of these when adopted should be worked in connection with a local battery.

Probably in practice it will be found advantageous to have a separate circuit distinct from the telephone circuit, on which a great number of selective signals may be connected.

Many sub-methods and appliances have to be thought of in considering this subject; whether we will be content to ring sub-stations from the central station only, or on the other hand give each sub-station the power of signaling others on the same circuit.

If step-by-step apparatus be employed to successively bring the station appliances to their ringing points, some means is required to prevent the bells of intermediate stations from giving a signal as they are passed. Sometimes the time element may here be utilized. But a better way is to have the call bell in a local circuit open at two points, to let the advance of the apparatus close one of these, and then send a different kind of current to close the other.

We have to consider also whether the introduction of line-in-use signals, unison apparatus, call sending appliances, and telephone lock-out apparatus, are sufficiently important to be added.

The unison or zero device in some form may be considered as an essential auxiliary in all progressive signals, whether

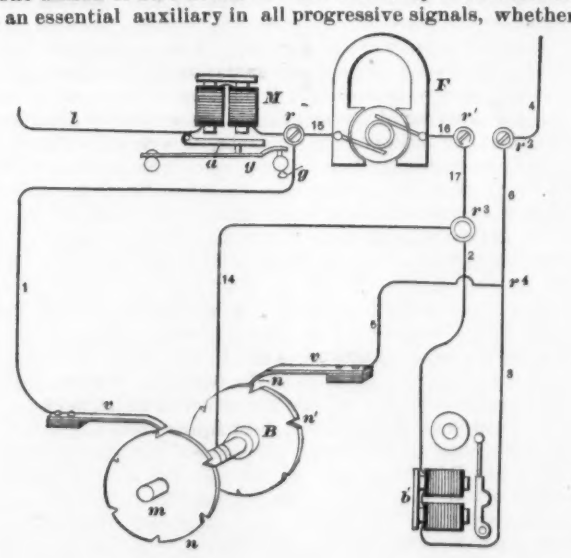


FIG. 7.

of the clockwork or step-by-step orders. Even the most perfect mechanism slips occasionally, and as in the stock printing systems where instruments "throw out" or get out of step with each other, a suitable zero at which all can periodically be brought to rest, and start even, must be certainly required. A "busy" signal which indicates at each station whether the line is in use at any other is useful, but not essential. And lock-out apparatus, usually provided by closing a shunt circuit round the call sending mechanism and telephones, at all stations on a circuit, except the one or two which are actually communicating, is also highly advisable in order that privacy and freedom from interruption may be maintained.

But, while some of these devices are necessary, and all useful if reliable, the contriver from this time forward must keep at all times before his eyes the undoubted fact that selective signals where heretofore tried, have uniformly been handicapped by being too intimately associated with too many such auxiliary devices, and must be correspondingly cautious about the way in which they are added.

Some such mode as is depicted in Fig. 7 is best for this purpose.

In the figure, M is a clock tripping magnet, F the magneto generator for sending outgoing calls, b the station bell, and m and n two metallic wheel commutators mounted on and electrically connected with the same shaft B. Arranged to press on the periphery of m is a contact spring v' and similarly placed with respect to n is a spring v.

When the station mechanism is at rest, it is desirable to have the generators in the line circuit, but the bells out. Accordingly the bell is short-circuited through the disc n, spring v, and wires 14 and 5, while a possible shunt circuit round the generator through disc m, spring v' and wires 1 and 14 is open, the spring v' being over the notch.

The notches of m are placed alike at all stations, but those of n differ at all stations; and therefore as soon as the shaft B begins to move, when the driving clock train is tripped, the shunt circuit is established round all the station generators, and no station can interrupt by an attempt to send a call signal.

Such a device is well enough because it can generally be added without at all impeding the operation of the signal proper, and in any case constitutes a perfectly proper adjunct to the equipment of a party line. But when associated with selective signals the greatest care is necessary to provide that the arrangement is such that the auxiliary appliance may not prove a drag on the signaling mechanism.

Selective signals require a fair field and all the favor they can get.

Railway Train Lighting.*

BY A. H. BAUER.

The first successful system of railway train lighting is that invented by Houghton, and adopted by the London, Brighton and South Coast Railway of England, in 1881-2. Since then the many improvements suggested by other inventors have made it almost automatic.

The system consists of a Brush dynamo carried inside the baggage compartment, and directly connected by link belting to pulleys on the axle of the car. Attached to the dynamo is a ball governor, rotating vertically, whose office is as follows:

1. To control the movement of a switch, which when the speed and therefore the E. M. F. of the dynamo reaches a predetermined value closes the circuit, and also opens it again when the E. M. F. approximates that of the secondary battery.

2. The adjustment of a resistance which maintains the current constant, and

3. To shift the position of the brushes as the neutral point is changed by the varying speed of the armature.

But one set of brushes is used, carried in rectangular holders, at right angles to the commutator, and always in contact with it.

When the rotation of the armature is reversed by a change of direction of the train, the brushes are carried forward or backward by the friction on the commutator and a connection with the governor until the quadrant passes but a fraction beyond the vertical, when it is drawn to the proper position by a spring, the action being similar to that of the snap switch. Limiting stops are provided to prevent the quadrant going too far.

The same movement of the quadrant also changes the position of a switch controlling the connection of the field coils, and therefore the polarity of the dynamo. It therefore follows that the current is always in the same direction, no matter which direction the armature may rotate. One set of accumulators, consisting of 25 cells, is provided for each train, and placed in the baggage compartment. The maximum number of lamps in a train is 70, of 10 c. p. each, at 50 volts.

No attendant is necessary, but at certain stations on the line an examination of the plant is made, and required repairs attended to. I am informed the system is so reliable that since the year 1888 but two failures have occurred.

It will be noted that the key of this system is the convenience with which the connection between the armature pulley and that on the axle can be made.

Throughout Europe the rigid wheel base is universally employed under railway cars; consequently, by setting the dynamo across the car, the armature shaft will always be parallel with the axle, and the connecting belt runs in practically the same plane.

In this country the bogie truck is exclusively used. Several attempts have been made to drive dynamos by connections with the axle of bogie trucks. All, however, have failed, for the reason that no provision was made for maintaining the armature shaft and axle parallel at all angles of the truck, and because sand, dirt, etc., gathered by a moving truck will soon destroy any mechanism that may be used for the purpose under the car. The problem, however, has not been abandoned, and I am in hopes that within a very short time a solution will be found.

Numerous propositions have been made to use primary batteries for car lighting, but I am not informed of a successful installation of that character.

Secondary or storage batteries have been more or less employed for the purpose, with varying success. The first attempt in this direction was made in 1887-8 on two Pullman limited trains, of six cars each.

Each car was equipped with 30 cells of battery, having a capacity of 150 ampère hours, and weighing 50 pounds per cell, or 1,500 pounds per car. Duplicate sets were kept charged at each end of the line, and on arrival of the train, exchanged for those that had been exhausted while on the road. The average number of lamps per car was 26, of 16

* A paper read before the American Institute of Electrical Engineers.

c. p., at 60 volts, or a total of 156 in the train. After 60 days' trial it was clearly demonstrated that, under existing conditions, the system could not be made successful, and it was abandoned.

The reasons for its failure were—1st, that the capacity of the battery was insufficient to maintain the number of lamps required for the proper lighting of Pullman cars on long runs.

For example, the current required for 26 60-volt, .8-ampère lamps, is about 20 ampères. Therefore $\frac{150}{20} = 7\frac{1}{2}$ hours, that is to say, 1,500 pounds of battery was able to maintain 26 lamps but 7½ hours. These trains leave eastbound at 5 P. M., but the light is required at 4 P. M. for inspection, receiving passengers, etc. Consequently the batteries would become exhausted at 11 P. M.; in fact, it would be earlier, as will be explained. Therefore the oil lamps would have to be used when light was required during the remainder of the trip. Westbound the same reasons held good, although not to the same extent, because the train leaves that end in the morning, and passengers will, as a rule, after 12 hours traveling, retire earlier than those going east, leaving at 5 P. M. Consequently less light is required, and a certain percentage of the charge is not used.

A second reason was the deterioration of the batteries themselves, which were of the pasted grid type. It was found that the constant agitation of the acid solution in the jars, as well as the unavoidable rough usage to which they were subjected when changing, caused a loss of the paste or active material, proportionately reducing the capacity. In fact, close observation indicated the loss during one handling to be equal, if not more, than that caused by 1,000 miles travel on the car. The paste, when separated from the grid, accumulates in the bottom of the jar, or lodges between the plates, forming a circuit through which the cell is discharged, resulting in the buckling and sulphating of the plates, and the destruction of the positive elements within a short time. This was five years ago. Since then, improved methods of manufacture, as well as more intelligent care in handling, has, to a great extent, overcome their objections and thereby increased the life of the battery. It may be asked—why not increase the size and therefore the capacity of the cell? The reply is—that to properly light a train of six Pullman cars, for instance, between Chicago and Jersey City, with the number and kind of lamps above stated, would require 30 cells, each weighing not less than 100 pounds—a total of 3,000 pounds per car, or 18,000 pounds for a six car train. The expense of handling and changing such a weight would make its use almost prohibitory, for each cell would have to be handled singly. The weight on the car would also be objectionable. Since these experiments were made, car lighting for short distance only, from storage batteries, has been made successful. For the past two years four cars, each equipped with 32 cells of 150 ampère hours capacity and 26 16-c. p. 60-volt lamps have been running between Chicago and Cincinnati, and Chicago and Indianapolis. Two of these cars are charged every day at Chicago for about nine hours with sufficient current for a round trip. The batteries, however, are not changed; the cars are always placed on the same side track to which wires from the dynamo are led, and the charging is done without removing them. The average length of time the light is required during a round trip is six hours; the cars leave each end of the line at 8 and 9 P. M. respectively. Repairs are made by removing the defective cell and substituting another if necessary.

The cost of repairs and renewals of all kinds from September, 1891, to January, 1892, inclusive, per month, was as follows:

September, 1891	$36.44
October, "	108.82
November, "	51.24
December "	79.21
January, 1892	38.31
Total	$314.0

which, divided by four, is $78.50 per car per month, or $2.61 per car per day, and this divided by 26 gives 10c. as the cost per lamp per day. As the engine and boiler are used for furnishing power for other purposes while running the charging dynamo, it is difficult to get the cost of the power for charging these batteries; that factor, therefore, is not included in the above statement.

In January, 1888, a solution of the problem of lighting six-car trains for long distances was sought for in another direction. Two trains running between Jersey City and Jacksonville, Fla., a distance of 1,100 miles, were selected for the experiment. At first an attempt was made to utilize the power of the axle, but for reasons already stated did not prove successful.

The next step was the substitution of a vertical single stroke engine, located in the baggage car, for the axle connection. This engine was belted to the dynamo and was supplied with steam from the locomotive boiler.

While this plan seemed to be a step in the right direction, it still had its objections, due to the fact that the upward and downward movement of the driving rod acted in the same manner as would a heavy blow on the car body, so that the latter would vibrate in unison with the stroke of the engine.

After a few trials, the vertical engine was removed and a three-cylinder reciprocating engine, with 3-inch cylinders and 4-inch stroke, was substituted. It was connected direct by a flexible coupling to a 75-volt 60-ampère dynamo of the ordinary open frame type, and both run at 1,000 revolutions per minute.

The working of this combination clearly demonstrated that a solution of the problem was attainable, and it was now possible to guarantee a fairly successful lighting of the two trains. A fault soon developed, which could not be anticipated. It is well known that all railway trains, while running, gather more or less dust and dirt, but it was not known until train lighting was attempted that this dust and dirt contain certain quantities of carbon and metal which adhere to armature and field wires, and being conductive form short-circuits. So frequently did this occur, that it became necessary to carry an extra armature with each plant, and make changes while the train was in motion. Later in the year these dynamos were removed, and the Eickemeyer installed. The Eickemeyer dynamo seems to be perfectly adapted for train lighting. As both the armature and field coils are protected by the iron of the machine, the dust and dirt do not reach the wire, except in small quantities, and by removing it every six months, when the car is shopped for repairs, short circuits have been prevented. Its strong construction is such that it will successfully withstand the general rough usage to which machinery of this character is subject on railway trains.

The system which has been used for the past five years on all Pullman trains consists of a Brotherhood three-cylinder engine and Eickemeyer dynamo, bolted to a cast-iron bed-plate, and located in the forward end of the baggage car, occupying an inclosed space of 6 feet 6 inches by 3 feet 3 inches. The engine and dynamo are connected by a flexible coupling which allows for the irregularity should they not be in perfect line. A two-gallon sight feed pressure lubricator bolted to the end of the car furnishes oil to all wearing parts of the engine. The average consumption of oil is about one gallon every 20 hours of actual running of the engine.

Steam is taken from the locomotive boiler, a tap being made at the dome, the pipe passing under the tender and car, between which a flexible rubber hose makes connection. It has been found that with 1½ inch pipe between the boiler head and car, there is a loss of 15 pounds pressure due to friction and condensation; therefore, to run the engine with 50 pounds requires 65 pounds at the supply pipe on the locomotive. With 50 pounds pressure, the dynamo will at 900 revolutions generate 80 ampères, at 72 volts, when all the lamps and batteries in a six-car train are in circuit, and 50 to 75 ampères, at 80 to 85 volts, at the same speed when the batteries alone are connected, depending on the counter E. M. F. of the batteries.

On the side of the car is placed an automatic switch, which will break the circuit when the E. M. F. of the dynamo equals that of the batteries. A voltmeter and ammeter are kept constantly in circuit while the plant is in operation. A tachometer, belted to the armature shaft, is also provided for noting the speed of the engine and dynamo. This plant is inclosed by a tongue-and-groove partition surmounted by a wire screen.

The system of wiring adopted is the equipotential, in which the pressure is practically equal at each lamp and battery. One wire leads from the positive pole of the dynamo to the rear end of the rear car, where it is coupled to a second that returns to the baggage car—but not to the dynamo—being tapped, however, by the positive pole of each battery and one side of each lamp. A third wire leads from the negative pole of the dynamo to the rear end of the rear car, where it ends. This third wire is tapped to the negative pole of each battery and the remaining side of each lamp.

All the batteries and lamps are therefore in multiple arc. Double pole, fusible cut-outs are placed in each circuit, and, with the switches, are located in the closets of each car. The wires are always placed on the roof of a car. For this purpose, whitewood molding, thickly coated with asphalt paint, is nailed from end to end as near the centre as possible, usually one and three-quarter inches from the edge of the smoke jack, if the car is equipped with centre oil lamps, and from 6 to 24 inches when gas lamps are applied. Branch moldings extend to all points on the roof through which it is desired to run wires to the lamps, switches, etc., inside the car. For instance, the drops to the centre lamps in the body of the car pass directly through the centre of the roof into the air chamber of the oil lamp, from where they are suitably connected. Those leading to the switches, cut-outs and batteries pass through the panels between the ventilators and into the closets, where the switches are located, the batteries continuing on through the floor to the boxes under the car. After being run in the molding, the wires are covered with wooden capping and the whole tinned over, practically forming part of the roof. The grooves in the molding are made of such size as to hold the wire rigidly, so that its movement or abrasion is impossible. Wire so applied has, after five years' service shown no deterioration whatever, and is apparently serviceable for at least five years more. As the tin covering of the molding is cut and worn away by cinders and the action of the elements, it is found necessary to renew the molding about once a year. The sizes of wire used are all of B. & S. gauge, and consist of No. 2 for those leading from the dynamo, Nos. 6 and 10 for the lamp mains, and No. 14 for the lamp drops. The connection between cars is made by bringing the wires from the roof through the hood to the inside of the vestibule, where they terminate in square brass tubing called connectors, which are permanently attached to the vestibule frame. The connection between these connectors is made with three conductor flexible cables, each conductor of No. 6 gauge. To the ends of each conductor brass springs are attached which fit closely inside the tubing, giving about eight square inches contact. If cleaned occasionally this connection will carry 100 ampères without sensibly heating. As the connectors are placed horizontally it is evident that should the train from any cause be parted, the connection will be severed without damage to any part of the system, except to throw the load off the engine, and cause it to race. Should this occur, which, in fact, is very seldom, the attendant is at hand to cut off steam and stop it until the connector can be replaced. With a No. 2 wire the average fall of potential in a six-car train is nine volts.

When the batteries alone are in circuit the E. M. F. of the dynamo will be from 67 to 83 volts, which, minus the loss, will overcome the counter E. M. F. of the batteries, viz., 57.6 to 73.6 volts. When both lamps and batteries are in circuit the external resistance is of course produced and the E. M. F. of the dynamo falls in proportion, and that at the lamps will be from 60 to 66 volts.

It is unnecessary to use a resistance in the lamp circuit, as when the lamps are first turned on, the E. M. F. being, say 66, a greater candle power is had just at the time when most needed, which, however, gradually falls and ordinarily reaches 60 to 61 volts in from two to four hours, depending upon the amount of charge in the batteries. It is true that this is at the expense of the life of the lamp, but as the handling of the switches is done by the porters and conductors, the use of rheostats or regulators, no matter how simple, would complicate the system and probably cause the total extinction of the light. Each car is provided with 32 cells of storage batteries, placed 16 in each of two boxes, securely fastened under the centre and directly over the truss rod. The weight of batteries and boxes complete is about 2,000 pounds. As already stated, with the system of wiring adopted, the batteries and lamps are permanently connected in multiple arc, so that should the train be parted and connection with the dynamo become broken the batteries will supply current necessary to maintain the light; or should the batteries under one car become disconnected, its lamps will be supplied from batteries under other cars in the train.

The lamp equipment of a six-car Pullman train is as follows:

Combined smoking and baggage car	21 lamps.
Dining car	32 "
Three sleeping cars	90 "
Combined observation and sleeping car	29 "
Total	172 lamps.

Of this number 98 are 16 c. p. and 74 are 8 c. p. The latter are placed in hallways, toilet rooms and vestibules.

During six months of the year seven ⅛ h. p. fan motors are added, viz., 3 in the dining, 2 in the smoking and 2 in the observation cars, each absorbing the current of four 16. c. p. lamps, or a total of 28, which, added to the 172, makes the total 200 lamps in the train. To maintain the 200 lamps requires 144 ampères. As the dynamo will generate but 80, the batteries must supply 64 ampères, or 34 per cent. This is effected by charging the batteries during the day and part of the night *en route*, and while the train is standing in the yards.

The following, taken from the January records of a train, will give an idea of the number of lamp hours required:

CHICAGO TO JERSEY CITY.

Time.	Hours.	No. of Lamps.	Lamp Hours.	
4 A. M. to 9 P. M.	5	172	860	Leaving Chicago.
9 " 11 "	2	140	280	
11 " 12 "	1	42	42	
4 " 7 "	3	172	516	Arr. at Jersey City.
During day in tunnels and depots.	1	172	172	
Total			1,870	

JERSEY CITY TO CHICAGO.

Time.	Hours.	No. of Lamps.	Lamp Hours.	
4 P. M. to 9:30 P. M.	5½	172	946	Leavg. Jersey City.
9:30 " 11 "	1½	140	210	
11 " 12 "	1	42	42	
6 A. M. to 7:30 A. M.	1½	32	48	Arrivg. at Chicago.
During day in tunnels and depots.	1	172	172	
Total			1,418	

Total, 3,288 lamp hours during the round trip.

The cost of an installation for a six-car Pullman train, consisting of one combined baggage and smoking, three sleeping, one dining and one combined sleeping and observation car is as follows:

COMBINED BAGGAGE AND SMOKING CAR.

1 Brotherhood engine	$500.00
1 Eickemeyer dynamo	500.00
32 cells accumulators	392.00
Wiring	100.00
1 set wire connectors	11.00
Battery boxes, crates and connections	71.00
Steam piping, lubricator gauges, etc	155.00
Voltmeter and ammeter	77.50
Safety switch	12.00
Lamps and sockets	17.00
Switches and cut-outs	17.50
Shades—holders and fixtures	10.80
Partition for dynamo and engine	38.00
Two ⅛-h. p. fan motors	76.00
Miscellaneous	50.00
	$2,027.80

SLEEPING CAR.

32 cells accumulators	$392.00
1 set wire connectors	11.00
Wiring	90.00
Battery boxes, crates and connections	71.00
Lamps	15.00
Sockets, receptacles, etc	47.00
Switches and cut outs	17.50
Shades and shade holders	9.00
Berth lamps	90.00
Miscellaneous	20.00
	$762.50

DINING CAR.

32 cells accumulators	$392.00
One set wire connectors	11.00
Wiring	70.00
Battery boxes, crates and connections	71.00
Lamps	16.00
Receptacles and fixtures	32.00
Switches and cut-outs	17.50
Three ⅛-h. p. fan motors	114.00
Miscellaneous	20.00
	$743.50

COMBINED SLEEPING AND OBSERVATION CAR.

32 cell accumulators	$392.00
One set wire connectors	11.00
Wiring	90.00
Battery boxes, crates and connections	71.00
Lamps	14.50
Sockets, receptacles and fixtures	19.50
Shades and holders	10.40
Berth lamps	45.00
Two ⅛-h. p. fan motors	76.00
Miscellaneous	20.00
	$749.40

A total of $5,808.20, or an average of $968.00 per car.

As the fan motors are used but six months in the year, the average number of lamps will be 172 + 14 = 186. Therefore the cost of equipment per lamp will be $5,808.20 ÷ 186 = $31.22.

The average cost of labor and material for maintaining the lighting of three trains or 18 cars for 19 months, from August, 1890, to February, 1892, inclusive, was as follows:

Average total cost per month	$1,265.95
" " per car per day	1.99
" " of labor per month	712.39
" " " per car per day	1.11
" " of material per month	511.51
" " " per car per day	.87
" " per lamp per day	.07.17
Average number of lamps in use	558

The item of labor includes the wages of five attendants on the train, at $3 per day each, and two men at each terminal station, at $90 and $55, and $75 and $50 per month respectively.

That of material includes the cost of renewal of batteries, etc.

The cost of labor is practically constant, while that of material varies from 12 cents to $2.04 per car per day, the average for 19 months being 87 cents. The cost per lamp per day varies from 3.8 cents to 12.5 cents; the average is 7.17 cents.

The cost of power furnished by the locomotive boiler is not included in the statement, for the reason that a satisfactory measurement of the quantity of coal and water used has never been made.

So long as the dynamo can be run, and the batteries properly charged, the system is reliable.

During the coldest part of the winter, or, as sometimes happens, when a poor quality of coal is furnished, it is difficult for the locomotive to supply sufficient steam to run the dynamo. In such cases the batteries are called upon to maintain the light. As a rule, they have sufficient charge to do so for about four hours. Trains so equipped have been run between Jersey City and St. Augustine, Florida, during the months of January, February, March and April of each year since 1888.

The conditions there are decidedly more favorable, for the reason that the trains leave both terminals early in the morning. In consequence, the dynamo is run nearly all day, and the batteries are therefore fully charged and in condition to furnish current for the maximum number of lamp hours. So successful has been the electric lighting of these two trains, that it is rare for other sources of illumination to be used. The system has also been used on other trains, viz., between New Orleans and the City of Mexico, Omaha and San Francisco, Chicago and Portland, Me.

Several specials have also been similarly lighted, notably —the Presidential, from Washington to San Francisco and return, the National Electric Light Association trains, between Jersey City and Chicago, and Jersey City and Kansas City; the National Telephone Exchange Association train to Minneapolis, and that of the Pan-American delegates, which was almost constantly on the road for three weeks.

A duplicate of this system was tried for a short time on the Chicago, Milwaukee & St. Paul Railway. I must look to others to explain the causes for its being abandoned, and also describe that which has been substituted and which it is understood has proven very satisfactory. One of the most serious sources of trouble met with in train lighting was the effect of the vibration of the car on different members of the plant. At first it was almost a daily occurrence to have lamps drop out of sockets—the shade-holders, which were made of thin sheet brass, were broken at the rate of 8 or 10 during one trip. Trains would arrive at terminal stations with two or three batteries out of circuit caused by connections between cells being broken. In the earlier days it was the practice to use a rigid connection between battery cells, as it was considered best to prevent the elements moving in the rubber jar. It was soon discovered that the element would move irrespective of the rigid connection, and in doing so would break the terminal, and in a majority of cases the fracture was next to the plates. As we had no means of burning the lug on again the element was useless. To overcome this difficulty flexible connections were substituted.

Contrary to all expectation no damage was done by the movement, and since then should a terminal be broken which however is seldom, it is in every instance due to a defect in burning on at the factory. Cast brass shade holders were substituted for those of sheet brass. To prevent shades working loose and dropping out, ordinary rubber bands were placed under the lip, against which the holder screws were driven, and they having a soft foundation were prevented turning and held the shade in place. The cause of the lamps falling out was due, in a great measure, to the socket rings working loose. This was overcome by the invention of a tool that would drive the ring into place much tighter than was possible by hand. Many minor causes of trouble that could not be foreseen were eliminated as fast as they developed.

A system of safety cut-outs was devised that protect each wire in the car. They are placed on the same baseboard with the lamp switches, and are located in the locker or closet, convenient for inspection and renewal. Later on portable lamps were demanded that could be placed in the sleeping car sections, either before or after the berths had been made up. For this purpose No. 18 wire was connected to one of the lamp circuits on the roof, and led to a connecting block placed over the mirror between the windows in each section. Connection with the block was made with a plug, to which flexible lamp cord was attached. On the other end of the cord a frosted 16 c. p. lamp was connected, the lamp hanging from an arm which was placed in a receptacle in the corner formed by the side of the car and the partition between sections, and immediately over the shoulder of the passenger, the most favorable position for the lamp when used for reading.

It was early seen that the only uncertainty connected with the system is due to the absolute dependence upon the locomotive boiler for power to run the dynamo, for, as explained, there is a constant liability of the failure of the steam supply, which, if prolonged beyond the capacity of the battery, will result in the use of oil or gas for light. As many other problems connected with the system have been successfully worked out, it is believed that the solution of this one will also be found.

There is no doubt that the ideal way of running the dynamo is by a connection with the axle. Many apparent solutions have been suggested, only to be condemned as uncertain or impracticable. It is, however, thought that within the next year a reliable connection will be had, after which I believe the lighting of railway trains by electricity will be universally adopted.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, June 4, 1892.

The stock market has been entirely one-sided this week, and consequently lacking in interest. The bears seemed to start out after the holiday with the idea that they would own the market, and though they have not beaten down the prices very many points, they have materially influenced the course of the market and held speculation within a very narrow channel. As for some time past, the traders have set the course of the prices, and there is very little active interest taken by the outside public. Prices have not varied very much during the week, but their daily fluctuation, and the varying conditions of strength and weakness, show that there has been a great deal of arbitrage business on the market. Better reports from the West have already had a favorable effect on certain stocks. Monetary conditions remain unchanged. Rates continue at their lowest, and certainly will remain there for some time to come.

Electric Stocks.—Even on a quiet and uninteresting market, such as we have had during the week, the electric stocks have maintained their position or even improved it. Westinghouse developed renewed strength, both in New York and Boston, which is apparently well backed up. The stock closes higher than a week ago, and shows evident prospects of better prices, as soon as the general market condition shall permit of a renewal of interest and activity. There has been a fair inquiry for Westinghouse preferred. Limited lots sold early in the week at 93¼. At the close 94⅛ was bid and 95⅛ asked. The strength was due to the excellent showing made by the annual report, both on the reorganization and general financial conditions. On Wednesday Westinghouse E. and M. assenting certificates sold at 59¼. A fair inquiry raised the quotation to 59¾, the closing on Friday. Thomson-Houston and Edison have been very quiet, and at the same time strong. They have maintained their strength at almost the highest prices. General Electric Company rights to the new bonds have sold in small quantities down to 25 cents. A great many of these will come out before the date of subscription. To-day one-half per cent. was offered for rights to subscribers to the $4,000,000 bond issue. Application to have the stock listed on the New York Stock Exchange was made Friday, and will be passed upon by the governing committee to-day. Inasmuch as it is exchanging share for share with Edison General Electric, its first sales will in all probability be at the latter's current quotation, or 111¼. Western Union is still moving upward and this week has scored a further advance. If its present strength continues it may yet fulfill some of the extravagant claims that have been made for its future course. The pending dispute between this company and the Bell Telephone Company as yet has had no effect upon the stock of either company, unless it may be giving strength to the former. This stock opened May 1 at 92⅝@93 and touched 95 Friday. The undercurrent has been gradually upward and has been led by S. V. White, who is backed by parties who absolutely control the stock. The practice has been to sell it at a certain figure early in the week and buy back at the close at a fraction off, each round of transaction being on a slightly higher plane of prices. By this method they have succeeded in making money, and at the same time elevate quotations. In an interview Friday Mr. White said: It is as certain as anything can be in the stock market that Western Union directors will next Wednesday declare 1¼ on the stock. The company already has in bank the money needed for the dividend and $250,000 more. I regard it as certain that the directors of the Western Union at their September meeting will either raise the rate of dividend to six per cent. or declare a stock dividend which will raise the capital to $100,000,000. American Telegraph and Cable was active early in the week at 86½@87. Commercial Cable was as usual strong. It was steadily bid 155, and held firm at 159 on Tuesday down to 157 Saturday.

The General Electric Company, in a recent circular to the holders of trust receipts exchangeable for stock of the company, states that rights to subscribe for the five per cent. gold bonds of the company are assignable, so that any person acquiring "rights" by assignment may make a subscription in like manner as if he were a stockholder of such trust-receipts exchangeable for stock. As five shares of common stock of Thomson-Houston Electric Company represented by trust receipts are exchangeable for three shares of the common stock of the General Electric Company, and four shares of the preferred stock of the Thomson-Houston are exchangeable for one share of the preferred stock of the General Electric, the privileges attaching to the certificates or receipts representing said common and preferred stock of the Thomson-Houston are respectively on the equivalent of three rights for every five shares of the Thomson-Houston common stock and one right for every four shares of the Thomson-Houston preferred stock. The $4,000,000 five per cent. gold debenture bonds subscription expires June 7. The officers of the company state that they have all been subscribed for. The rights have sold at three-eighths per cent. premium.

To Issue Bonds.—Stockholders of the Edison Electric Illuminating Company of New York, at the meeting May 31, authorized an issue of $1,000,000 five per cent. gold bonds, to which stockholders of record June 11 will be granted the right to subscribe. The Charleston Light and Power Company, of Charleston, S. C., in addition to increasing its capital stock, referred to elsewhere in this issue of THE ELECTRICAL WORLD, will also issue bonds, the object in issuing part bonds and part stock being that after paying six per cent. on the bonds there will remain much larger earnings to the $100,000 of stock, which the company will be capitalized at, than if the entire amount invested was represented by stock, it being expected that the earnings available for dividends on the stock will warrant a much higher rate of interest on the stock than the six per cent. interest on the bonds. The Norway Water Power and Electric Light Company, of Norway, Maine, will issue bonds.

The Metropolitan Telephone and Telegraph Company through the Mercantile Trust Company, trustee under a certain mortgage dated May 1, 1888, and an agreement dated Nov. 1, 1888, invites proposals for the sale on July 1, 1892, of bonds secured by said mortgage at a price satisfactory to the Metropolitan Telephone and Telegraph Company, at a rate not exceeding par and 10 per centum premium, to such an amount as shall not exceed the sum of $20,000.

Increase in Capital Stock.—The Taunton Electric Light Company, of Taunton, Mass., has voted to increase its capital stock by $10,000; the Reading, Pa., Electric Light Company, has increased its capital stock by $30,000; the Mobile, Ala., Electric Light Company has voted to increase its capital stock to $100,000; the Edison Electric Illuminating Company, of New York, has voted to increase its capital stock from $2,000,000 to $6,500,000; the Charleston Light and Power Company, of Charleston, S. C., has increased its capital stock from $50,000, to 100,000; the Worcester, Leicester and Spencer Street Railway Company, of Worcester, Mass., has voted to increase its capital stock from $250,000 to $375,000. At the special meeting of the NorthWest Thomson-Houston Electric Company referred to elsewhere in this issue the question of making an addition of $750,000 to the capital stock will be voted upon, making the total capital $1,750,000 One million ($1,00,000) of said capital stock shall be common stock, and shall be issued in such manner and at such times as the Board of Directors determine. Seven hundred and fifty thousand dollars of said capital stock shall be preferred stock to be issued as the directors may determine; the dividends on the preferred stock, however, shall not exceed eight per cent, per annum, but shall be cumulative, that is, if not earned and paid in any year, shall be paid out of the first net profits of the company accumulating or made thereafter. The number of shares of the corporation shall be seventeen thousand five hundred (17,500) of $100 par value each.

Dividends.—A quarterly dividend of two per cent. has been declared by the Northwest Thomson-Houston Electric Company. The Taunton, Mass., Electric Light Company, has declared a dividend of seven per cent. Westinghouse electric shareholders expect a 3½ per cent. dividend in July, and such is the confidence in its being declared, that three per cent. has been bid for it.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, June 4, 1892, in New York and Boston:

NEW YORK QUOTATIONS.

Name of Stock.	Par.	Capitalization.	Bid.	Ask'd.
American Cable	...	.....	86	85½
American Telegraph Co.	100	14,000,000	60	63
Western Union Telegraph Co.	100	86,200,000	94½	94⅝
Commercial Cable Co.	100	7,716,000	155	160
Edison Electric	100	15,000,000	110¾	111
Edison Illuminating Co., of New York	100	4,500,000	79½	80
" " " Brooklyn	100	750,000	76	80
" " " Chicago	100	750,000	138	142
U. S. Illuminating Co.	100	1,250,000	30	35
Edison Elec. Light Co. (of Europe) stock	100	2,000,000	2½	5
Edison Elec. Light Co. (of Europe) bonds	sh	30,000	65	75½
" Ore Milling Co	100	2,000,000	15	20
" Toy Phonograph Mfg. Co	10	1,000,000	....	⅛
Brush Illuminating Co., of New York	50	1,000,000	40	50
Mt. Morris Electric Light Co.	..	500,000	20	40
East River Electric Light Co.	100	1,000,000	....	60
North American Phonograph Co.	...	6,600,000	5	8
New York Phonograph Co.	...	2,000,000	3	4
Automatic Exhibition Co.	...	2,000,000	3	6
New England Phonograph Co.	...	2,000,000	1¾	2¾

BOSTON QUOTATIONS.

	Par.	Capitalization.	Highest.	Lowest.	Bid.	Ask'd.
Thomson-Houston Elec.	25	6,000,000	66¾	65¼	65½	66
Thomson Houston Elec. preferred	25	4,000,000	30	29¾	29¼	29½
Thomson-Houston Elec.—Series C	sh	40,000	9	....	8¾	9
Thomson-Houston Elec.—Series D	sh	120,000	....	....	7⅛	7¼
Thomson-Houston Int'n'al Elec.	100	600,000	....	....	240	245
Thomson-Houston Int'n'al Elec—Pfd.	100	400,000	....	....	103	105
Thomson Elec. Weld.	100	1,000,000	....	....	45	50
Thomson European Elec. Weld.	100	1,500,000	10	....	10	12
Westinghouse Elec.—New Com.	..	6,000,000	30	29¾	29¼	29¾
Westinghouse Elec.—Pfd.	..	4,000,000	48	47	47	47¼
Fort Wayne Elec.	25	4,000,000	12⅞	12⅛	12½	12⅝
FortWayne Elec.—Ser. A.	sh	80,000	7½	....	7⅝	7¼
Detroit Elec.	10	1,000,000	8	...	8	8¼
West End St. Ry. Co.—Com	50	7,150,000	76	75	75⅛	75¼
West End St. Ry. Co.—Pfd	50	6,400,000	90	89⅛	89¾	89⅞
American Bell Tel	100	15,000,000	209	208	208	209
Erie Tel. & Tel. Co.	..	4,800,000	46	45	45	.....
Mexican Tel. Co.	10	1,280,000	....	....	1	1.10
New Eng. Tel. & Tel. Co.	..	10,304,600	54	....	53½	.....
Tropical Tel. Co.	10	400,000	25	....	20	25

NEW INCORPORATIONS.

The National Gas and Water Company, of Chicago, Ill., capital stock $500,000, has been formed to build, lease and operate electric and other works. C. D. Hauk, E. E. Morrell and N. A. McGlary are the promotors.

The Katahdin Mining Company, of Spokane, Wash., capital $100,000, has been incorporated to operate electric light plants, etc. A. M. Mason, H. T. Mallen, B. Norman, Ralph L. Clarke and C. Happy are the incorporators.

The Citizens' Electric Company, of Battle Creek, Mich., capital stock $50,000, has been formed to furnish electricity for lighting that town. William Andrus, M. M. Lewis and William H. Mason, of Battle Creek, are the organizers.

The Gordon Electric Company, of Chicago, Ill., capital stock $10,000, has been organized to manufacture and sell, etc., all kinds of electrical machines, etc. Walter J. Gunthorp, Jean Elliott and Marion E. Moore are the incorporators.

The Lowell Electric Light Company, of Lowell, Mich., has been incorporated, with a capital stock of $60,000. The incorporators are Otto C. McDonnell, Chas. A. Church, C. Jesse Church, Mrs. Alice E. McDonnell and Mrs. Grace F. Church.

The Norway Water Power and Electric Light Company, of Norway, Me., capital stock $50,000, has been formed to purchase water powers and develop same. H. L. Horne, C. N. Tubs and F. H. Noyes, of Norway, are the promoters.

The Chicago Electric Light Enlarging Company, of Chicago, Ill., capital stock $5,000, has been formed to manufacture and sell photographs, photographic prints, frames, etc. Adolph Graeff, Alfred Graeff and Jesse Cox are the promotors.

The City Electric Company, of Port Huron, Mich., capital stock $100,000, has been formed to operate a street railway from Port Huron to Fort Gratiot. The incorporators are Albert Dixon, S. L. Ballentine and William Canham, all of Port Huron.

The Belle Vernon Electric Light Company, of Belle Vernon, Pa., capital stock $1,000, has been incorporated to supply light, heat and power to that town. J. S. Van Voorhis, A. C. Brown and J. C. Cunningham, all of Belle Vernon, are the incorporators.

The Magnetic Electric Company (incorporated in West Virginia), of Boston, Mass., capital stock $5,000,000, has been formed to manufacture and deal in electrical apparatus. W. D. Northenn, W. F. M. Collins and A. J. Lowd, Salem, Mass., are the organizers.

The Carroll Electric Company, of Portland, Me., capital stock $75,000, has been incorporated to manufacture and deal in electrical apparatus of all kinds. Frederick V. Chase, John B. Keboe and George H. Allan, all of Portland, are the parties interested.

The Chadron Electric Light and Power Company, of Chadron, Neb., capital stock $20,000, has been formed to supply the city of Chadron with electric light for public and private uses. Jas. W. Boyd and Thos. A. Coffey, both of Chadron, are the incorporators.

The McConnelsville Malta Electric Company, of McConnelsville, O., capital stock $10,000, has been organized to furnish light and power to McConnelsville, etc. H. B. C. Vincent, John A. Adair, F. M. Beckett, Irven Traves and Elmer A. Taylor are the promoters.

The Lowell Electric Light Company, of Lowell, Mass., capital stock $60,000, has been formed to generate electricity for lighting purposes. C. J. Church, of Greenville, and Occto C. McDonnell and Alice E. McDonnell, both of Lowell, Mich., are the organizers.

The North Manufacturing Company, of Denver, Colo., capital stock $100,000, has been formed to manufacture, buy and sell batteries and motors of all kinds operated by electricity. John D. North, W. L. Beardsley and B. A. Ambler, of Denver, Colo., are the corporators.

The Pine Grove Water, Light and Power Company, of Pine Grove, Colo., capital stock $15,000, has been formed to furnish water and electricity to the inhabitants of Pine Grove. The promoters are Charles W. Dake, Theo. W. Horr and Willis B. Horr, all of Denver.

The Lewisburg Light, Heat and Power Company, of Lewisburg, Pa., capital stock $12,000, has been formed to supply light, heat and power or any of them to Lewisburg, Pa. Chas. S. Pardee, Frank S. Marr and Jno. F. Duncan, of Lewisburg, are the incorporators.

The Electrical Supply and Construction Company, of Pittsburgh, Pa., capital stock $100,000, has been formed to manufacture electrical supplies and appliances. M. D. Card, H. M. Doubleday, both of Pittsburgh, and William M. Galbraith, of Chartiers, Pa., are the incorporators.

The Johnston Motor and Electric Company, of Portland, Me., capital stock $250,000, has been formed to manufacture and deal in all kinds of electrical appliances. W. C. Johnston, C. W. Higgins, both of Melrose, Mass., and Charles A. True, of Portland, Me., are those interested.

The Nutley Electric Light, Heat and Power Company, of Franklin, N. J., has been formed, with a capital stock of $100,000, to manufacture and supply electricity, etc. C. H. McIntire, Newark, N. J.; E. Teeter, H. Edgar, Franklin, N. J., and F. W. Ward, of East Orange, N. J., are the promoters.

The Peoples' Electric Light and Power Company, of Silver Creek, N. J., capital stock $20,000, has been formed to manufacture and use electricity for light, heat and power. Theo. Gresbno, Albert H. Stebbins, H. W. Alsen, Frank P. Stewart and Charles Hamond, all of Silver Creek, are the incorporators.

The Delaware Electric Street Railway, of Delaware, O., capital stock $60,000, has been formed to build and operate an electric street railway, furnish light, power, etc. Jas. K. Newcomer, V. T. Hills, J. D. Van Demon, B. W. Brown, W. A. Hall, C. Riddle, F. M. Marriott, Robert G. Lybrand, H. J. McCullough, H. A. Welch and James M. Crawford are the incorporators.

The Pierce & Miller Engineering Company, of New York City, capital stock $100,000, has been formed to manufacture, furnish, buy and sell machinery of all kinds and contract for electric and manufacturing plants. Francis M. Pierce, 51 West Thirty-seventh street; Ferdinand Schmerber, 190 West One Hundredth street, New York City, and John D. Miller, 76 Rodney street, Brooklyn, are the incorporators.

AFFAIRS OF THE COMPANIES.

The Thomson European Electric Welding Company will hold its annual meeting in Portland on June 8.

The Norway Water, Power & Electric Light Company, of Norway, Me., at a recent meeting of the directors chose F. H. Noyes general manager.

The Johnson's Creek Electric Light and Power Company has elected the following officers: Geo. C. Mansfield, president; H. J. Grell, vice-president; J. D. Bullock, secretary, and H. C. Christians, treasurer.

The Ontario Telephone Company at its annual meeting at Peterborough, Ont., unanimously adopted the report of President Kendry recommending that the stock of the company be sold to the Bell Telephone Company.

The Jenney Electric Light and Power Company, of Logansport, Ind., at its annual meeting elected Joseph Seiter president, and Brainard Rorison vice-president. Victor E. Seiter was made secretary, treasurer and manager.

The Taunton Electric Light Company, of Taunton, Mass., at its annual meeting re-elected its old board of officers, declared a dividend and authorized an increase in capital stock, as is stated elsewhere in this issue of THE ELECTRICAL WORLD.

The Crescent Insulated Wire and Cable Company, of Trenton, N. J., recently suffered quite a severe loss from a fire in its factory, which destroyed the roof and fourth floor. As the factory was taxed to its utmost capacity the loss from this interruption will be strongly felt.

The Kenton Gas and Electric Company, of Kenton, O., at its annual meeting elected the following officers: Thomas Espy, president; L. Merriman, vice president; E. C. McVitty, treasurer, and W. S. Robinson, secretary; Finance Committee, G. W. Rutledge, J. M. White and Dr. J. N. McCoy.

The Edison Electric Illuminating Company, of New York, at a meeting of its stockholders May 31, authorized an increase in capital stock, and an issue of bonds, referred to elsewhere in this issue of THE ELECTRICAL WORLD, for the purpose of making extensive betterments of the company's system.

The Brush Electric Company, of Baltimore, Md., recently elected the following directors: Messrs. Summerfield Baldwin, Dr. William Whitridge, Edgar G. Miller, Francis E. Waters, James E. Hooper, Lloyd L. Jackson, of Baltimore; George W. Hebard and Philip Ferd. Kobbe, of New York, and W. C. Clark, of Pittsburgh.

The Northwest Thomson-Houston Electric Company will hold a special meeting in St. Paul, Minn., on June 15. The purpose of the meeting, it is stated, is to take action on changing the by-laws of the company, to provide for the election of a second assistant treasurer. The articles of incorporation will also be amended, so that the name of the corporation shall be the Northwest General Electric Company. This will make it a department of the new General Electric Company, as its interests are to be consolidated with those of the other companies in the consolidation.

The Worcester, Leicester & Spencer Street Railway Company, of Worcester, Mass, at a recent annual meeting voted an increase in its capital stock referred to elsewhere in this issue of THE ELECTRICAL WORLD. It was also voted to hold the annual meeting in October, instead of May, so that the books may be balanced yearly and a report made to the stockholders at the same time that a report is made to the Railroad Commissioners. The following officers were elected: President, S. Winslow; clerk, T. T. Robbins.

Indianapolis, Ind.—The Brush and the Marmon-Perry companies have been consolidated, and the new company under the name of the Indianapolis Light and Power Company will control electric lighting in Indianapolis in the future. The new company has been capitalized at $600,000, but more than this will be required to purchase the three plants and construct the new city system. It is understood that the price to be paid for the Brush plant is about $250,000, and the cost of the Marmon-Perry plants will be about $125,000. It is expected that Mr. Marmon will be elected president and Mr. Perry secretary and treasurer.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, June 6, 1892.

Mr. George Elcock has been chosen secretary of the new Subway Commission.

The Steam Engineering Department at the Brooklyn Navy Yard has installed a new electric welding machine.

An Electrically Lighted Buoy.—The submarine cable, two miles in length, connecting the dynamo station on Sandy Hook with the new electrically lighted buoy on Southwest Spit, has been laid. The buoy marks a sharp right-angle turn for heavy-draught vessels. The red incandescent light on the buoy will be displayed on and after the night of June 15.

Proposed Electric Lines.—It is proposed to construct a trolley line along Columbus avenue to 110th street, making connections through 106th street with the existing tracks on Amsterdam avenue. It is also reported that the Broadway syndicate contemplates introducing electricity on all its lines where the cable has not been laid, which would include Sixth and Ninth avenues. To this end the company is endeavoring to procure the consent of the property holders along the way. It is proposed to make arrangements with the Manhattan Elevated Railroad Company to suspend the trolley from the elevated structures. L. H. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., June 4, 1892.

H. K. Porter, Boston, Mass, reports a fair sale for his electric wire cutter.

The Waters Electrical Company, formerly of Brockton, Mass., has recently established itself in Boston, at 54 Lincoln street.

Israel B. Oliver, formerly of Lynn, Mass., dealer in new and second-hand electric motors and dynamos, has moved to 84 Lincoln street, Boston, Mass.

The Newton Rubber Company, Boston, Mass., manufacturers of hard rubber storage battery jars and rubber springs for horse and electric cars and motors, are receiving many orders for these specialties.

Messrs. Swan & Lane, 194 Summer street, Boston, have entered upon business as electrical contractors under very favorable conditions, and at the very start they report having as much as they can attend to.

The Eastern Electrical Supply Company is moving its store and offices from 65 Oliver street to 77 Arch street, having found that the old place could not be made large enough to accommodate their rapidly increasing business. W. R. W.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, June 4, 1892.

Mr. Leo Daft was in Chicago this week en route from Seattle to New York.

Mr. Paul W. Bassart will represent the National Electric Manufacturing Company in Chicago, and for the present has established his headquarters in Room 931 The Rookery.

Miles & Hale, of St. Paul, have completed the wiring of St. Luke's Hospital for both incandescent lights and call bells and the placing of speaking tubes throughout the building. Another contract just completed is the entire electrical work in Ham's new bottling works.

Mr. George Cutter will address the Chicago Electrical Association at the Athenæum Hall, June 14, on the subject of "Thomson's Induction Experiments." His lecture is to be illustrated with the aid of special apparatus constructed by himself. All interested in alternating current phenomena will be welcomed.

A Sad Bereavement.—Mr. C. E. Lee, the Western representative of the Electric Gas Lighting Company, will have the sympathy of his many friends in the loss of his wife, who died at their residence, No. 532 Belden avenue, Chicago, on Friday, June 3. Her remains will be interred at Rochester, N. Y., her former home.

Mr. Edward H. Fox, the Western Agent of the Phœnix Glass Company, has opened convenient showrooms at 19 and 21 Wabash avenue, Chicago, where his many customers will find samples of all that is new in electric glass ware. Mr. Fox will be found in these rooms from 2 to 5 P. M. during the first 10 days in each month, and will take pleasure in meeting every one interested.

Mr. F. W. Cushing, the Western representative of Kerite, not only has a complete stock of all sizes of Kerite covered wires in stock ready for immediate shipment, but also has some most interesting letters and other mementos from well-known users of this insulation, handsomely framed. In addition he also has framed some rare portraits of noted electricians in Europe.

From Out of Town.—Among the visitors in Chicago this week are: Mr. J. W. McDowell, of the Manhattan Electrical Company, of New York, en-route from Minneapolis to St. Louis; Mr. F. W. Brigham, of the Atlantic Covering Company, Boston, en-route from St. Paul to the East; Mr. C. A. Daigh, vice-president of the National Electric Manufacturing Company, Eau Claire, Wis. Mr. J. W. Godfrey, manager of the New York Insulated Wire Company, happy and jovial as a winner always is.

To Inspect the Westinghouse Works.—To familiarize themselves with the capacity of the works of the Westinghouse Electric and Manufacturing Company, the Committee on Grounds and Buildings, which recently awarded the contract for lighting to that company, have been invited and will visit Pittsburgh for the purpose of inspecting the plant of the company and satisfying themselves as to the ability of the company to perform the contract which it has undertaken for lighting the world's fair buildings.

The National Electric Manufacturing Company, Eau Claire, Wis.—Vice-President C. A. Daigh, in assuming the general management of the company, has made the following appointments in the various departments: Mr. Carl Kammeyer to be electrician; Mr. R. Walter, formerly with A. L. Ide & Son to be general superintendent; Mr. Maurice E. Bates, formerly manager of the Western Electric Construction Company, of Kansas City, to be superintendent of construction, and Mr. Will Smith to continue as auditor and also to be assistant to the vice-president.

Contractors for large office buildings are often put under heavy time forfeits, especially where failure to complete the building at a certain time means the loss of thousands of dollars to the owners. This necessitates in a great many cases work at night and the question of illumination then becomes a very important one. For this work the Ward arc lamps have been largely used and night has been thus turned into day. The loose wires feeding the lamps can be thrown around anywhere and the lamp can be carried about as a lantern and suspended in almost any position. Among other buildings in which they were employed are the Woman's Temple, Unity, Great Northern, *Herald* and *Daily News*.

The Lincoln Club had a house warming in their new home on West Adams street, near Ashland avenue, on Thursday evening, and the first president of the club, Mr. Chas. A. Brown, formerly manager of the Western Electric Company, Chicago, and now of the law firm of Barton & Brown, had the honor of welcoming a large and distinguished body of guests. Among the speakers of the evening were Senator Shelby M. Cullom, General Nelson A. Miles, Lieut.-Gov. Ray and others. In introducing Senator Cullom President Brown said: "There is lots of patriotism abroad in the land, but it needs a channel in which to flow in order to become useful. Patriots, unlike poets, are made, not born. The Lincoln Club makes them and furnishes a channel for their activity. We are proud of the name our club bears, and we consider it an honor that on this the inaugural meeting in this club house we have with us a friend of Abraham Lincoln, Senator Shelby M. Cullom." F. DE L.

TACOMA, Wash., May 27, 1892.

The American District Telegraph Company, of Seattle, recently placed 100 improved return call boxes in service.

The American District Telegraph Company, of Tacoma, was recently incorporated with a capitalization of $25,000.

The Lynden Electric Motor and Railway Company, of Lynden, Wash., has been incorporated with a capital stock of $250,000.

The Union Electric Company, of Seattle, has made several electric light extensions. The recently installed Edison arc dynamo is in successful operation.

The Albina Light and Water Company, of Portland, Ore., has contracted with the Northwest Thomson-Houston Company for one 500-h. p. electric railway generator.

The Northwest Thomson-Houston Electric Company has closed a contract with the Tacoma Railway and Motor Company for ten 30-h. p. car equipments and ten 50-h. p.

The Seattle City Council has passed a joint resolution providing for the forfeiture of the Seattle Electric Railway Company's franchise if it persists in refusing to erect and maintain street lights along its line.

The Western Union Telegraph Company's new extension from Seattle to Sumas City, Wash., is completed into Snohomish. The extension was completed to Woodinville Junction some time ago, but work was stopped temporarily by an injunction procured by the Postal Telegraph Company.

The Raineer Power and Railway Company, of Seattle, for which Chas. H. Baker & Company are building five miles of electric railway, is about to let a contract for the extension to Ravenna Park and Yesler, the distance being 2¼ miles from the terminus in Brooklyn addition. The track will be of 45-pound girder rails laid on stringers.

Seattle, Wash.—It has been reported that an Eastern syndicate has secured an option for a short time on the stock of the Seattle Gas, Electric Light and Motor Company, and has paid $30,000 as earnest money. The gas company has an exclusive franchise, having yet about seven years to run, and has asked for an extension for 25 years from the passage of the ordinance.

The Sunset Telegraph and Telephone Company's new line from Tacoma to Seattle is about completed, and the construction force is to be transferred to the line to Portland, Ore. The Seattle Exchange placed 37 new telephones in connection last month and now has 850 in use. The company will open an exchange in Everett next month, beginning with 40 subscribers.

L. W. Storror, general Pacific Coast superintendent of the Pacific Postal Telegraph Company, who recently visited Puget Sound and British Columbia, said it was the intention of the company to make important extensions in the State of Washington. His company will soon begin the construction of a line eastward from California to Colorado, which will be 1,200 miles long, will cost $350,000, and will give another outlet for Eastern business.

The Arnold Novelty Company, of Tacoma, has been again reorganized. Rush W. Kimball is president, E. N. Costello secretary, A. F. Espersen manager. The capitalization will be $15,000. The manufacturing of the Arnold flexible brackets will be transferred to Chicago in July, to enable the company to fill the many Eastern orders on its books. The Arnold flexible electric bracket is now in use on the U. S. S. Yorktown, lately in Puget Sound waters.

The Tacoma Railway and Motor Company has practically acquired the ownership of the Tacoma & Steilacoom Railway Company's property, including a power house and about 13 miles of electric line. The former company will have a total of 40 miles of trackage in operation. If the property owners will subsidize the company, the extension and summer resort plans projected near Steilacoom will be carried out. A counter-weight electric line will be built up Ninth street in Tacoma to Tacoma avenue. A new generator has been ordered, which will increase the electrical horse power of the power station to 1,300.

The Tacoma Railway and Motor Company, which entered into a contract with the Northwest Thomson-Houston Company, under which the former company bought the Tacoma & Steilacoom Railway, has received notice that the General Electric Company has ratified the contract. In connection with this the Tacoma Railway and Motor Company has floated its bonds. Its previous mortgage will be cancelled and a consolidated mortgage will be issued upon the combined property. About two miles will be added to the company's trackage in the near future. The mileage is now about 40. The new 900-h. p. engine has been shipped by the Frick company, and by June 1 the company will probably be supplying current to the Point Defiance, Tacoma & Edison line, in addition to its own lines. A 370-h. p. generator and 20 car equipments have been ordered. G. R. DE V.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, May 18, 1892.

The Telephone and Electric Traction.—It is evident that the time is rapidly approaching when the question whether the telephone companies are to run complete metallic circuits or whether the electric lines are to be seriously interfered with will have to be settled by the law. In Parliament the National Telephone

Company are endeavoring to get a clause inserted in the Blackpool Improvement Bill obliging the municipality of Blackpool in the event of their taking over the local electrical tramway to arrange their circuits so as not to interfere with the telephone service. On Friday the Western Counties and South Wales Telephone Company endeavored to obtain an injunction against the Bournemouth Electric Lighting Company. The telephone company first of all asked for a complete injunction there over one week, and finally for an injunction forbidding the company to start operations until after 8 at night. In the result it was decided that the Board of Trade should inspect the electric lighting company's system and make a report, and that the Court should then hear further evidence.

The London Electric Railway Schemes.—The Joint Committee of Lords and Commons appointed to consider the question of electric traction and to decide whether or no the projected schemes are such as will afford a satisfactory solution of the London rapid transit problem, commenced its work on Monday. The parochial authorities, including even the London County Council, seem favorably disposed to the general idea of tubular railways and electric traction and have apparently given up any hankering after "spoil" in the shape of royalties for the use of the sub-soil. Indeed a sensible suggestion has actually emanated from the County Council; it wisely proposes to make a stand against the tubes being constructed of so small a diameter that the rolling stock of the existing steam railways cannot pass through them. There is a wide consensus of opinion that neither narrow tubes nor a break of gauge ought to be allowed. In fact we are just beginning to realize in this country that electricity may ere long find a place even on our trunk lines. Mr. Greathead was the first expert called on by the committee, and stated that one of the projected lines, viz., the Waterloo Station City line, would be able to carry fifteen million passengers per annum with a five-minute service and twenty-six million with a three-minute service. He also stated that the diameter of the tunnel which was going to be run by the Great Northern Railway Company would be 16 feet and capable, therefore, of taking that company's ordinary rolling stock. The committee appeared well satisfied that electricity was equal to the task and decided to call only one electrical expert, Mr. W. H. Preece.

The National Telephone Company and Its Sheffield Subscribers.—The National Telephone Company has been clearly shown at Sheffield that the British public, though long suffering, *can* be roused. Having silenced opposition by the purchase of the local telephone company the National company immediately issued a revised tariff. Exactly what this tariff is I am unable to state suffice it to say, that it proved decidedly obnoxious to the inhabitants of Sheffield. A meeting was called by the leading citizens, and although held in the largest hall in the town, people were turned away from the door. The telephone subscribers, from the chairman downward, were one and all in a most pugnacious mood, and determined not to submit to the National Telephone Company's charges at any cost. A delightful variety of expedients was suggested by successive speakers. Way-leaves were to be refused, both by private individuals and by the town council, subscribers were to withdraw from the exchange in a body, a local company was to be formed, the New Telephone Company was to be invited to come to Sheffield. The general manager of the National Telephone Company was present and was allowed a hearing before the conclusion of the meeting and made a most conciliatory speech. A committee was, nevertheless, appointed to hold a conference with the directors of the National company and to enter into negotiations with the New Telephone Company in the event of the conference proving unsatisfactory. At the time of writing, the National company has completely climbed down. The town council has received a letter from the general manager, begging them not "to whip a willing horse by denying way leave facilities," and the obnoxious tariff has been withdrawn. If the subscribers to the London Exchange were to exhibit one-half the determination of their Sheffield brethren, I make no doubt that the metropolitan service would not long remain the worst in Europe.

LONDON, May 25, 1892.

Manchester.—The Town Council of Manchester are about to expend the sum of £150,000 upon a municipal central station upon the five-wire system.

Death of Mr. Willans.—Mr. Willans, founder and head of the well-known firm of Willans & Robinson, of Thames Ditton, famous as makers of high-speed engines, was killed on Monday last by a carriage accident. The works at Thames Ditton, which were started but a few years ago, have rapidly developed themselves into the most perfect example of a modern steam engine plant that exists in the United Kingdom. Although Mr. Willans was best known in connection with the particular type of steam engine which bears his name, yet his various papers on thermo-dynamics and the construction of the modern steam engine show that his grasp of the science of the subject was second to none. Although frequently urged to throw some of his knowledge into the form of a standard book on the subject, Mr. Willans always deferred doing so *until he had time*. The greater part of the immense fund of practical knowledge which he had acquired of the idiosyncrasies of high-speed engines thus dies with him.

Chemistry of the Secondary Cell.—A lengthy paper, detailing some long investigations on secondary cells, was read a short time back before the Institution of Electrical Engineers by Messrs. Gladstone and Hibbert. The deduction which these gentlemen draw from their experiments is that the various changes in the electromotive force of the secondary cell are due mainly, if not entirely, to variations in the density of the acid around the plates during charge and discharge. They were led to make these investigations owing to a paper read by Dr. Armstrong and Mr. Robertson before the Royal Society last summer, in which these gentlemen attributed an important part in these variations in electromotive force to the presence in the electrolyte of hydrogen dioxide and persulphuric acid. In the discussion which followed the reading of papers Mr. Robertson was able to point to several facts which did not fit Messrs. Gladstone and Hibbert's theory. But it must be confessed that the controversy between these electro-chemists remains at present a drawn battle. Each side has damaged its opponent's case, but has not succeeded in proving its own contention.

London Electric Railway Schemes.—The Joint Committee of Lords and Commons appointed to consider the various electric railway schemes proposed for the Metropolis have reported to the Legislature. On Wednesday last Mr. Wolfe Barry, engineer to the City of London, gave evidence before this committee strongly disapproving of any break in the gauge and expressing the opinion that the size of the tubes of all the railways should be uniform. With regard to the enormous increase in first cost, which the carrying out of this idea, it is said, would entail, he thought that a line which could carry goods would be twice as valuable as one which could not. In reference to a proposal which had been before the committee to erect an enormous underground central railway station under the open space which is surrounded by the Bank, Royal Exchange and the Mansion House, Mr. Wolfe Barry was of opinion that the scheme must be very cautiously proceeded with, in view of the inevitable increase in the foot passenger traffic which would result. The corporation, he said, viewed the idea with considerable alarm owing to the enormous disturbance of gas and water pipes which would take place. The same gentleman gave some interesting statistics as to the comparative cost of the "inner circle" and the tubular system of railways. The former line has cost about a million sterling per mile as against £650,000 for a 16-foot tube and £370,000 for a 11½-foot tube. In their report the committee express the opinion that the lines in question will, *to some extent*, relieve the overgrown traffic along the chief streets of the Metropolis, and they further state that *the evidence submitted to them was conclusively in favor of the adequacy and sufficiency of electricity as a motive power* for underground tubular railways. As a return for the use of the subsoil without payment, the committee suggests that the companies should be placed under the obligation to furnish an adequate number of cheap and convenient trains for workmen. The electrical bills have now been referred to a Select Committee of the House of Commons. It is to be hoped that they will get through the two Houses before the general election.

News of the Week.

THE TELEPHONE.

Omaha, Neb.—The contract has been let by the Nebraska Telephone Company to the National Conduit Maufacturing Company for cement lined iron pipe and manholes for its underground cables in this city. Work is to be started by June 10 and finished by October. The contract will amount to about $50,000 and is the first of the outlays in the direction of underground wires and the new telephone building.

THE ELECTRIC LIGHT.

The Greenport Electric Light and Power Company, New York, has completed negotiations with the Heisler Electric Light Company for the lighting of the city. The company has purchased a new 160-light incandescent dynamo and fixtures for 25 street lights.

Menasha, Wis.—A new company is being organized under the name of the Menasha Gas and Electric Lighting Company, with a capital stock of $40,000. Chas. R. Smith, of Menasha Woodenware Company, is the principal stockholder. Besides electric lighting the company expects to furnish power to a number of manufacturing plants.

THE ELECTRIC RAILWAY.

Duluth and West Superior, Minn., will soon be connected by an electric railway.

Brooklyn, N. Y.—The Brooklyn City line on Hamilton avenue has been completed and was in operation on Monday.

Temescal, Cal.—The Thomson-Houston system is to be used on the new Telegraph avenue line. The work on the power house is progressing rapidly.

Norwich, Conn.—It is definitely settled that the new street cars will be run by electricity, and that the motive power will be furnished by the Oneco company.

Rochester, Minn.—An ordinance has been granted by the Common Council to W. W. Mayo permitting the use of certain streets and highways for the operation of an electric railway.

Fremont, O.—A strong effort is being made by Tiffin and Port Clinton capitalists to build an electric road between these two cities. A meeting in reference to the matter will be held this week.

The Broadway Railroad Company, of Brooklyn, N. Y., has decided to substitute electricity for horses on its line. An application will soon be made to the Common Council and the State Board of Railroad Commissioners for permission to use the trolley.

The Electric Street Railway Company, of Anderson, Ind., has obtained from the Elwood City Council a franchise to build and operate an electric street railway at that place. A franchise has been granted for 50 years. The contract stipulates that the company shall have at least three miles of electric street railway in operation by July 15, 1893.

LEGAL NOTES.

Western Union vs. Bell Telephone.—Judge Colt in United States Circuit Court has given a decision which will enable the Western Union to try over again its suit against the American Bell Telephone Company to transfer to it 20 per cent. of stocks, bonds and dividends of sub-companies, in accordance with contract of Nov. 10, 1879. The amount involved is about $12,000,000.

PERSONALS.

Mr. Henry W. Goode has been elected second vice-president of the Northwest Thomson-Houston Electric Company. His many friends will be pleased to learn of his success, and all those who are acquainted with his efficient work on the coast realize how well fitted he is to perform the duties of the office to which he has just been called.

An Electrical Duellist.—It may be of interest to electricians to know that Mr. Roulez, whose extraordinary feats in duelling was recently reported in our daily papers, is the inventor of a telephone transmitter well known in France. In a dispute arising from his criticism of the first representation of "Salambo" at the Paris Opera House, he was challenged by three adversaries to fight a duel with swords. Although he is over 50 years old, and his antagonists relatively young, he disposed of all three of them in a short time, each receiving severe wounds. One of the seconds lost his patience, and insulted the victor, causing a fourth duel, which resulted like the other three.

Obituary.—The reports from England record the death of Prof. Doctor James Thomson, followed a few days later by the death of his second daughter and that of his wife. Dr. Thomson is the brother of Sir William Thomson, now known as Lord Kelvin. He was lately professor of civil engineering and mechanics in the University of Glasgow. He was born in Belfast in 1822. In 1857 he became professor of civil engineering in Queen's College, Belfast, which office he held until the death of the late Prof. Macquorne Rankine in 1872. He was then elected to fill the Glasgow chair, which he held till 1885, when he was obliged to seek retirement owing to the failure of his eyesight. He was the author of a number of original papers on various subjects connected with physics. His articles on thermo-dynamics have done much in laying the way for the modern improvements in the steam engine.

MISCELLANEOUS NOTES.

Newspaper Electricity.—In reporting a lecture of Mr. Preece, a local paper says: "A kettle will boil with 100 'bolts' of electric light," and "paying for electricity not by the number of 'bolts,' but by a combination of them called 'wats.'"

The Royal Electric Company, of Montreal, Can., as soon as authority is obtained from Ottawa, expects to utilize the Chamberly Rapids as a source of power. Four dams will eventually be constructed capable of furnishing 20,000 h. p. Only one dam of 500 h. p. will be built at present. The wires are to be carried across the river either in metallic pipes filled with oil or overhead by means of special towers built on St. Helen's Island.

Mr. J. Murota, of Seattle, Wash., in a recent communication states that two new forms of insulation for wires have been brought out in Japan by Mr. Yamadi Yoshichi, director of the Yamada Electric Wire Works, Yokohama, Japan. Both the insulating materials are produced in Japan. One is made of Japanese paper and some kind of vegetable oil and the other of Japanese wax and chemical compounds. Very high insulation is claimed, and the process is said to be remarkably cheap.

The Electric Commission of New Orleans has promulgated the following rules to apply to street railways: "Systems in which motor cars are driven by current from a single wire with ground return circuit are prohibited, except when no other conductors come in contact with the trolley wires and no fire hazard is feared and when an automatic circuit breaker exists to cut off the current if the wires become grounded. All wires in cars must be run out of the reach of passengers, and must have water proof insulation. Light-bearing and power wires are not permitted on a circuit with ground return wires, except upon street railway cars, car houses and power stations."

Industrial and Trade Notes.

W. S. Chesley & Co., with offices in the Electrical Exchange building, is now local agent for the Easton Electric Company's apparatus, and is meeting with great success. It still continues as dealer in new and second-hand electrical apparatus of all kinds.

The Samson Cordage Works, of Boston, Mass., has been increasing its plants for the manufacture of the Samson arc light and trolley cord. Having reached the limit of the present water supply the company has purchased a water power in the neighborhood, and will transmit the power electrically.

The Waddell-Entz Electric Company, of New York, through Pascal P. Beals, of Buffalo, its agent for Western New York, has closed a contract for furnishing the passenger steamer Columbia with 140 lights. A Waddell-Entz direct driven dynamo is coupled to a Wells balanced compound engine. The construction is done by F. P. Jones & Co.

The Hine Eliminator Company, 106 Liberty street, New York, has received some very excellent testimonials of its eliminator from such sources as the Pratt Institute, Purdue University, Queen City Electric Company, of Cincinnati, and from Cornell University, where a competitive test was made. There seems to be an increasing demand for this useful article.

The Cowles Electric Smelting and Aluminium Company, of Lockport, N. Y., issues a neat little pamphlet setting forth the many good qualities of aluminium and the uses to which it can be put. This metal has properties which render it superior in many respects to any other, and it is coming more and more into use. The Cowles company furnishes aluminium in almost any form, including a good many important alloys.

The Gilbert Car Company has the contract to build a number of coaches for the new Adirondack railroad. The Anger truck manufactured by the Gilbert Car Company has been given a satisfactory test by the Albany railway. The truck has a six-foot wheel base, one foot less than the ordinary truck, and with a twenty-eight-foot car the truck is found superior to many now in use. About twenty five of these trucks are now in use in Paterson, N. J.

E. A. Williams & Son, 105-111 Plymouth street, Jersey City, N. J., is putting upon the market some very excellent wire solder. It is furnished in any size from No. 7 to No. 20 wire gauge, either in 250-pound coils or cut in 12-inch or 15-inch lengths, packed in bundles. The company also deals in solder that will melt at high temperatures, bell metal gongs, castings of all kinds, lead and tin wire, sheet lead, spelter solder, silver solder, Babbitt metal and absolutely tested fuse wire.

The Stearns Manufacturing Company, of Erie, Pa., proprietors of the Woodbury automatic high speed engine, are advised that the Franklin Institute has awarded to the Woodbury the Edward Longstreth medal, stating: "The sub-committee after witnessing the operation of several of these engines was impressed with the fact that the skill and intelligence displayed in the design and construction of the engine had resulted in a machine of handsome appearance, capable of close regulation of speed, smooth in its action, and well adapted for its purposes. Recognizing the integrity and skill displayed, your committee recommends the award of the Edward Longstreth medal of merit."

The Electric Appliance Company reports having closed arrangements with the Mica Asbetite Insulating Company to represent them in the Western market and carry a complete stock of their goods in Chicago. Mica Asbetite is one of the latest insulating compounds in the market for electric railway use, although it has been in use for some considerable time on some of the largest lines in the country. The Mica Asbetite compound is unaffected by heat, as in fact the appliances are subjected to a heat of over 800 degrees in the process of manufacture. The compound, it is claimed, resists water perfectly and the bells can be soaked in water or even acid for any length of time without affecting the compound.

The Edison General Electric Company has just designed and put on the market an automatic switch for use with electrically operated pumps employed in filling water tanks. This is a simple single pole switch with ebonite base, mounted upon an angle piece and operated by a ball float. As the water rises in the tank, the ball float rises with it until it reaches a point where the switch is opened by the operation of a spring. The motor consequently stops and no more water is pumped into the tank. As the water is drawn off, the ball falls with the water level, the switch is closed, the pump starts and continues working until the tank is again filled to the desired point. The ball, and all parts coming into contact with the water are insulated from the switch connections and line terminals, so that no part of the circuit can be grounded through the tank. Switches of this type can be used in connection with motors up to 2 k. w. capacity, and can be arranged to operate upon any reasonable change in water level.

The Thomson-Houston Mining Catalogue.—The Mining Department of the Thomson-Houston Electric Company has

just issued the first edition of its Catalogue No. 3 for 1892. This is undoubtedly the most complete and exhaustive catalogue of electrical mining apparatus ever published. It contains descriptions and illustrations of all the apparatus connected with the application of electricity to mining, from the central station down to the mining pump or coal cutter. Aside from the mere description of the different machines, much valuable information is given which it would be very difficult, if not impossible, to obtain elsewhere. Considerable space is devoted to both underground and surface haulage, to tunnel wi.ing, electric hoisting, electric elevators, coal cutters, drills, air compressors and blowers, water wheels, and more general subjects, such as the long-distance transmission of power. From a perusal of this catalogue one can obtain a very clear and practical idea of the extent to which electricity is applied to mining operations at the present time. Both the illustrations and the typographical work are very excellent, and the book presents a very attractive appearance.

Russell & Co. are making very large additions to their factory at Massillon, O., more especially in the department devoted to the manufacture of automatic engines. They report the following recent sales of automatic engines for electric light works: Deer Park Electric Company, Port Jervis, N.Y., 150 h.p.; Oshkosh Electric Light and Power Company, Oshkosh, Wis., two engines, tandem compounds, 500 h. p.; Western Electric Company, Chicago, Ill., factory, tandem compound, 330 h. p.; Petaluma Electric Light Company, Petaluma, Cal., 65 h. p.; Western Electric Company, Prairie City, Ill., 45 h. p.; Vernon Light and Water Company, Tallapoosa, Ga., 100 h. p.; Somerset Electric Light, Heat and Power Company, Somerset, Pa., 100 h. p.; Chartiers Valley Electric Light, Heat and Power Company, Mansfield, Pa., two engines, 300 h. p.; Massillon Light, Heat and Power Company, Massillon, O., two tandem compounds, 400 h. p.; Asbury Park Electric Light, Heat and Power Company, Asbury Park, N. J., 150 h. p.; Madison Electric Company, Madison, Wis., two tandem compounds, 500 h. p.; Defiance Light and Power Company, Defiance, O., 150 h. p.; Canton Street Railway Company, Canton, O., 150 h. p.; Electric Light and Power Company, Carterville, Ill., 60 h. p.; Garrett Electric Light Company, Garrett, Ind., 150 h. p.; Electric Light and Power Company, Moscow, Idaho, 125 h. p.; The Electric Light Company, Prospect, O., 60 h. p.

The Ball Engine Company has recently made the following shipments: Wilmington Street Railway Company, Wilmington, N. C., two 130-h. p. simple engines and complete steam plant; Chesapeake Light and Power Company, Hampton, Va., two 150-h. p. tandem compound engines and transmitting machinery; Moundsville Electrical Company, Moundsville, W. Va., one 130-h. p. simple engine; Niagara Falls Street Railway Company, Niagara Falls, N. Y., two 130-h. p. simple engines and steam plant complete; Electric Light Company, Elizabeth, N. C., one 100-h. p. simple engine; Philadelphia House of Refuge, Philadelphia, Pa., one 100-h. p. and two 50-h. p. simple engines; Edison General Electric Company, State House, Trenton, N. J., one 35-h. p. simple engine; Schuylkill Electric Railway Company, Pottsville, Pa., one 250-h. p. simple engine; Electric Light Company, Doylestown, Pa., one 130-h. p. simple engine; Somerville Hotel, St. Claire, Mich., one 35-h. p. simple engine and steam plant; Freeport Gas and Electric Light Company, Freeport, Ill., one 130-h. p. simple engine; Warrenton Electric Light Company, Warrenton, Mo., one 50-h. p. simple engine; Schuylkill Electric Railway Company, Pottsvile, Pa., one 200-h. p.; J. C. Hubinger Company, Keokuk, Ia., one 300-h. p. cross compound condensing engine; Oakland Light and Power Company, Oakland, Md., one 80-h. p. engine; North ave. Street Railway Compady, Balto., Md., two 150-h. p. engines; Jersey City and Bergen Railroad Company, three improved cross compound 300-h. p. engines.

Business Notices.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Molds for casting battery zincs are made of iron and steel. We have just completed sets for the "D'Infreville Patent Wasteless Zinc," costing over $40 each. H. Brooke, 44 Barclay street.

Thirty-five-light, 2,000-c. p. American arc dynamo in good condition, for sale at a bargain; also 750-light Westinghouse alternator, with station appliances. Address E. T. Pardee, 10 Butler Building, Syracuse, N. Y.

The Consolidated Electric Storage Company is now making almost every form and type of storage battery, and of such size as will fit the containing jars or cells of the Accumulator Company and other storage battery companies not now furnishing batteries.

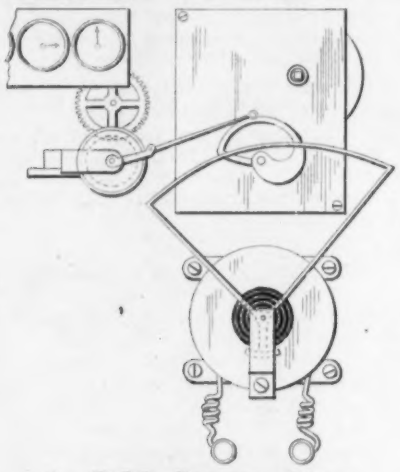
Burlington Route—New Service.—A through Pullman sleeping car, Chicago to San Francisco, is a feature of the Burlington's new service. This car leaves Chicago daily on the fast train at 1:00 P. M., and runs via Denver, Colorado Springs, Leadville, Glenwood Springs, Salt Lake City and Ogden, arriving in San Francisco at 11:45 A. M., less than four days *en route*.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

U. S. PATENTS ISSUED MAY 31, 1892.

475,759. Electric Meter; Oscar Ericsson, Sioux Falls, S. Dak. Application filed July 23, 1891. The combination, with a recording mechanism, of a lever or pawl through which motion is transmitted to the same, a continuously rotating cam adapted to move said lever, and another cam or sector controlled by the current to be measured, regulating the distance which the cam moves the lever. (See illustration.)



NO. 475,759.—ELECTRIC METER.

475,781. Electric Wire Holder; Edwin L. Lloyd, Philadelphia, Pa. Application filed Aug. 6, 1891. A line wire for insulators, having line wire supports and an engaging hook and loop whereby the holder is clasped upon the insulator.

475,783. Contact Post for Electric Bells; Frederick W. Manger and Otto H. Huebel, Brooklyn, N. Y. Application filed Feb. 29, 1992. The combination, with a base plate, of a bifurcated contact post fastened to the plate and a contact screw through the two limbs of the post.

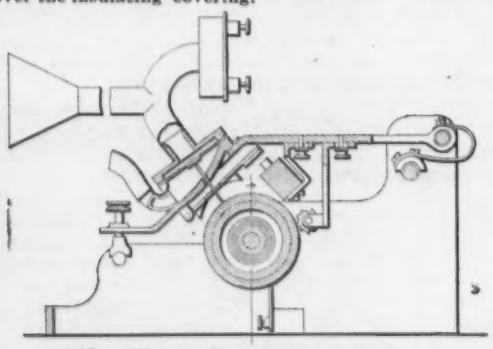
475,797. Secondary Battery Electrode and Process of Making the Same; Anthony Reckenzaun, London, England. Application filed Sept. 13, 1890. The method of forming a battery plate, which consists in progressively subjecting its surface to the action of the electric arc or spark, whereby the surface will become oxidized or physically changed.

475,809. Electric Self-Winding Clock; Frederick M. Schmidt, Brooklyn, N. Y. Application filed Oct. 9, 1891. In a self-winding clock, the combination, with a winding motor and the train operated thereby, of a circuit controller for the motor circuit, having alternate insulating and conducting sections and a contact bearing thereon, the circuit controller being independent of the train, but adapted to be moved step by step by the alternate engagement therewith of one of the wheels of the train and a part connected with the going-barrel.

475,877. System of Electrical Distribution; Cyprien O. Mailloux, New York. Application filed Nov. 25, 1891. The combination, in a system of electric distribution, of the consumption circuit or circuits, feed wires or conductors leading to different parts thereof from a common source, and a supplemental or auxiliary electromotive force generator or generators included in said feeder wires and having a normal action at full load adjusted with respect to the relative drop in the feeders. (See illustration.)

475,898. Rheostat; Frederick W. A. Schneider, Toronto, Canada. Application filed July 20, 1891. A resistance medium composed of saponified fat, contained in a suitable casing interposed in an electric circuit and fitted with terminals, to which the circuit wires are connected.

475,920. Electric Conductor; Charles W. Bassett, Newton, Mass. Application filed Feb. 1, 1892. An electric conductor, consisting of a metallic conductor, an insulating covering of seamless paper extending over the same, and a protective covering extending over the insulating covering.



NO. 476,054.—TELEPHONOGRAPH.

475,925. Automatic Fire-Alarm System; Charles Burgher, Newton, Mass. Application filed Jan. 29, 1892. In an automatic fire-alarm system the combination of a plurality of thermostatic circuits, each containing one or more thermostats; a plurality of test keys, one for each thermostatic circuit; test magnets, controlled by said test keys or circuit controllers; a recording apparatus; a local circuit, in which the said apparatus is located, and a plurality of circuit controllers for said local circuit, co-operating with the test magnets and operated thereby.

475,938. Telegraphy; Thomas Gothorpe, Rye, N. H. Application filed Aug. 15, 1889. The combination of a local circuit containing a key, battery, condenser, and the coils of a transmitting magnet, with the main line circuit and battery controlled by such magnet, whereby the battery is momentarily put to line.

475,955. Railway Signal System; William G. Wattson, Tappan, N. Y. Application filed June 17, 1891. In a block signal system, the blocks arranged in pairs and each provided with a series of electrically operated signals distributed throughout its length, an electric circuit connecting the signals of each series, an electric generator for each pair of blocks, and a switch arranged to throw the current from the generator into the circuit of either block.

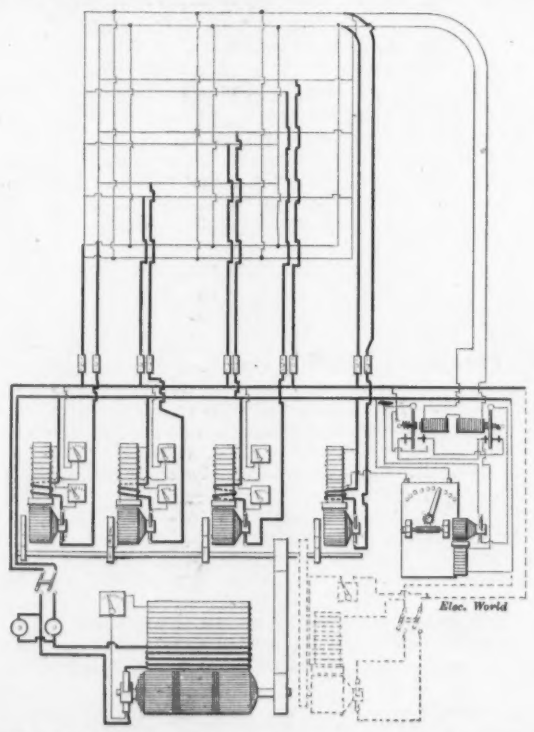
475,970. Electric Railway Motor; Jabea F. Shawhan, Detroit, Mich. Application filed May 10, 1891. The combination with the car axle of a motor supported thereon, the motor consisting, essentially, of two electromagnets and two armatures, the armatures being connected with the axle.

475,998. Seal for Leading in Wires; Henry D. Burnett, Lynn, and Samuel E. Doane, Swampscott, Mass. Application filed March 7, 1892. An incandescent electric lamp having a leading in conductor sealed in the glass of the enclosing globe and a yielding support for the leading in conductors near the point where it enters the glass.

476,007. Submarine Telephone; Henry Finch, Michigan City Ind. Application filed Oct. 23, 1891. A telephone comprising an electromagnet embedded in a water resisting compound.

476,026. Telephone; Stephen F. Sherman, New York. Application filed March 2, 1892. In a telephone transmitter, the combination of a vibrating diaphragm and a variable resistance connected therewith and included in the circuit, made of a piece of conducting material creased or folded to form plaits.

476,028. Safety Attachment for Railway Trolleys; Melvin A. Yeakley, Cleveland, O. Application filed April 7, 1891. A trolley safety device, comprising a drum or sheave, a cord or rope to be wound upon the sheave, mechanism for rotating the sheave, and means connecting the sheave and rotating mechanism, adapted to be operated by the movement of the sheave to release the rotating mechanism.



NO. 475,877.—SYSTEM OF ELECTRICAL DISTRIBUTION.

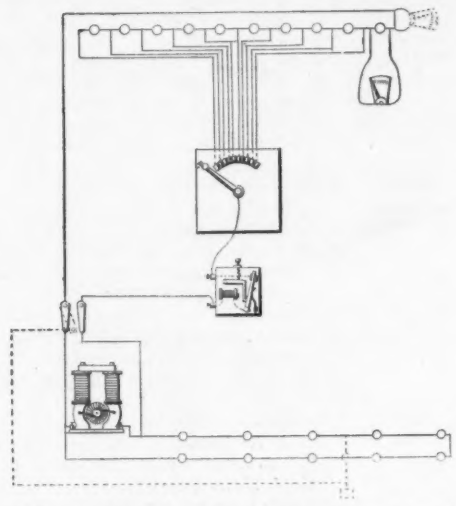
476,054. Telephonograph; James P. Magenis, North Adams, Mass. Application filed July 23, 1891. In a telephonograph or phonograph the combination with the phonograph diaphragm and recording stylus of a microphone arranged to be operated simultaneously with the phonograph diaphragm, armatures connected with the recording stylus, and an electromagnet arranged to act upon the said armature and placed in the circuit of the distant microphone. (See illustration.)

476,080. Electric Terminal; Hercules Sanche, Detroit, Mich. Application filed Sept. 29, 1891. A terminal fastening for electric and other wires, consisting of a post having a threaded shank projecting from a flat contact face on said post and a collar having a non-central opening entering its periphery on one side of a diametrical line and emerging on its flat upper face between the periphery and the central opening receiving the threaded shank.

476,128. Conduit for Electric Railways; Walter F. Carr and Charles F. Ferrin, Minneapolis, Minn. Application filed Aug. 6, 1891. A conduit provided with removable arch blocks spanning the parts of the arch adjacent to the slot openings, the blocks being detachably secured together and held in working position by lugs and lug seats.

476,151. Dynamo-Electric Machine; William Koedding, St. Louis, Mo. Application filed Jan. 31, 1891. In a dynamo-electric machine, the combination of cases adapted to receive the wire coils and the field magnet cores composed of thin plates arranged side by side in metallic contact in a line lengthwise of the magnet and having their poles set in the said cases.

476,156. Device for Testing Arc Light Circuits; Albert H. Manwaren, Philadelphia, Pa. Application filed Feb. 3, 1890. The combination of the main or arc light circuit, the shunt or test circuit containing a series of resistances, a switch for putting said resistances in or cutting them out of said test circuit, and a voltmeter or equivalent device whereby the proper adjustment of said switch is determined, one terminal of said meter being connected to the positive wire of the shunt circuit and the other terminal to the negative wire of the shunt. (See illustration.)



NO. 476,156.—DEVICE FOR TESTING ARC LIGHT CIRCUITS.

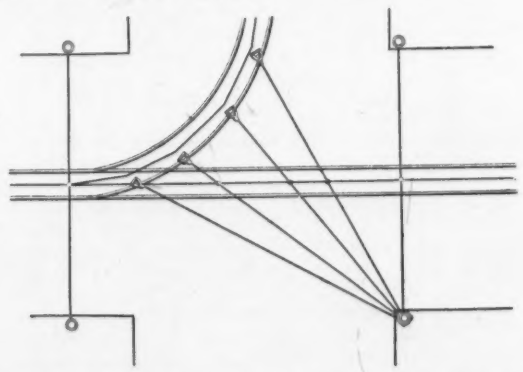
476,183. Incandescent Lamp; James Ball, Holyoke, Mass. Application filed Nov. 23, 1891. This invention relates to improvements in that class of incandescent lamps wherein are embodied two or more filaments, each of which are extended outside of the vacuum chamber, so that either of the filaments is available to be placed subject to the electric circuit, as circumstances may render advantageous.

476,192. Hanger for Electric Railway Wires; Charles B. Elliott, Boston, Mass. Application filed Nov. 30, 1891. In an insulating hanger a shell provided with a protecting cap and formed with an annular watershed or drip, in combination with the enclosed body of insulating material and the hanger imbedded in such material.

476,193. Swivel Pull-Off for Overhead Wires; Charles B. Elliott, Boston, Mass. Application filed Nov. 30, 1891. In a swivel pull-off or curve hanger for electric railways, a stirrup or exterior hanger having arms and an annular portion, in combination with a shell having a tubular neck of reduced diameter extending through the annular part, an interior hanger held centrally within the shell and neck, and with an interposed body of an insulating material, said hangers being adapted to be supported and strained from opposite directions. (See illustration.)

476,200. Telephone; Edward M. Harrison, Fort Smith, Ark. Application filed Aug. 9, 1890. A telephone case provided with a fixed top piece, an upper inclined door, hinged to the top piece and having a rabbeted outer or front edge, and also having the ringer secured to its under side, the case being also provided with a lower door fitting at its upper edge into the rabbet of the other door, and having secured to its inner side the phonetic transmitter.

476,207. Insulator Pin; Fred. M. Locke, Victor, N. Y. The combination with an insulator of a post having a vertical recess clear across the outer end and a layer of soft material interposed between the insulator and post.



NO. 476,193.—SWIVEL PULL-OFF FOR OVERHEAD WIRES.

476,225. Electrical Reciprocating Tool; William P. Carstarphen, Jr., Denver, Colo. Application filed June 1, 1891. This invention relates to an improved electrical tool, provided with a reciprocating plunger located and moving within the tubular spools of two coils or sets of coils of insulated copper wire, through which a direct current of electricity is alternately passed.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.